

FEATURING — WASHINGTON & JEFFERSON



The Biologist



Vol. XXII, No. 4

May, 1941



IGSTI — RESEARCH WITH COLCHICINE RETROSPECT

Phi Sigma

BIOLOGICAL HONOR SOCIETY

"The object of Phi Sigma is to promote interest in biological research. Although originally designated as an honorary biological research society, it should now be considered as a working guild of biologists interested in research. In effect, election to Phi Sigma should be an opportunity for better work, rather than merely election to an honorary society."

Mile Posts:

- 1915 March 17, Alpha Chapter organized, Ohio State University, Columbus.
- 1916 May, Central Governing Body organized, BIOLOGIST first issued.
- 1917 June, last War-time BIOLOGIST issued.
- 1921 February, BIOLOGIST revived.
- 1924 December, First National Meeting, Constitution revised, Washington, D. C.
- 1925 December, Second National Meeting, First Science Program, Kansas City.
- 1926 December, Third National Meeting, Second Science Program, Philadelphia.
- 1927 December, Third Science Program, Nashville.
- 1928 December, Fourth National Meeting, Coat-of-Arms adopted, Fourth Science Program, New York.
- 1930 January, Council Meeting, Ritual Revised, Norman, Okla.
December, Fifth National Meeting, Fifth Science Program, Cleveland.
- 1931 Phi Sigma Letters Registered, U. S. Patent Office.
- 1932 December, Sixth Science Program, Atlantic City.
- 1933 June, Sixth National Meeting, Seventh Science Program, Chicago.
- 1935 December, Seventh National Meeting, Eighth Science Program, St. Louis.
- 1937 December, Eighth National Meeting, Ninth Science Program, Indianapolis.
- 1939 December, Ninth National Meeting, Tenth Science Program, Silver Anniversary, Ohio State University, Columbus.

Expansion:

The Constitution provides that: "An active chapter may be established in any institution of learning which requires for graduation the equivalent of four years of collegiate work, and which is equipped with facilities for research work. - - - Any petitioning group must be active for at least one year before it may be granted a charter."

THE BIOLOGIST

Vol. XXII

Denver, Colo., May, 1941

No. 4

Published by the Phi Sigma Society, an organization devoted to the promotion of interest in biological research, founded at Ohio State University, March 17, 1915. The *Biologist* is the official quarterly publication of the society, issued ordinarily in October, December, February and April, as a medium of exchange between chapters, as an interpreter of Council policies, and as a stimulus to the fellowship in science for which Phi Sigma stands.

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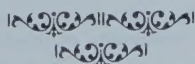
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Directory

OF ALL ACTIVE AND INACTIVE CHAPTERS

The list of chapter officers for this school year will be found in the CHAPTER NEWS section of Vol. XXII, No. 1.

ALPHA

Ohio State University, Columbus, Ohio, founded March 17, 1915, (Inactive).

BETA

University of Michigan, Ann Arbor, Michigan, founded June 3, 1916

DELTA

University of Maine, Orono, Maine, founded January 27, 1917, (Inactive).

EPSILON

University of Denver, Denver, Colorado, founded March 5, 1917.

ZETA

University of Wisconsin, Madison, Wisconsin, founded May 30, 1917

ETA

University of Akron, Akron, Ohio, founded April 20, 1921.

THETA

Michigan State College, East Lansing, Michigan, founded April 9, 1921, (Inactive).

IOTA

Washington University, St. Louis, Missouri, founded May 28, 1921.

KAPPA

University of Kansas, Lawrence, Kansas, founded May 31, 1921.

LAMBDA

Montana State University, Missoula, Montana, founded May 4, 1921.

MU

University of California, Berkeley, California, founded April 27, 1922.

NU

Washington and Jefferson College, Washington, Pennsylvania, founded May 11, 1922

XI

University of Nebraska, Lincoln, Nebraska, founded May 3, 1934, (Inactive).

OMICRON

University of North Dakota, Grand Forks, North Dakota,
founded May 26, 1924, (Inactive).

PI

Emory University, Georgia, founded January 3, 1925.

RHO

University of Illinois, Urbana, Illinois, founded March 28, 1925.

SIGMA

University of Florida, Gainesville, Florida, founded December 4, 1925.

TAU

Duke University, Durham, North Carolina, founded March 4, 1926.

UPSILON

Miami University, Oxford, Ohio, founded May 7, 1926.

PHI

University of New Hampshire, Durham, New Hampshire, founded May 21, 1926.

CHI

Montana State College, Bozeman, Montana, founded February 11, 1927.

PSI

University of Washington, Seattle, Washington, founded April 7, 1928.

OMEGA

University of Oklahoma, Norman, Oklahoma, founded March 24, 1928.

ALPHA ALPHA

University of Southern California, Los Angeles, California, founded May 17, 1930.

ALPHA BETA

Mount Union College, Alliance, Ohio, founded May 17, 1928.

ALPHA GAMMA

University of South Dakota, Vermillion, South Dakota, founded May 15, 1928, (Inactive)

ALPHA DELTA

Lawrence College, Appleton, Wisconsin, founded March 7, 1929, (Inactive).

ALPHA EPSILON

University of Pittsburgh, Pittsburgh, Pennsylvania, founded March 23, 1929.

ALPHA ZETA

College of William and Mary, Williamsburg, Virginia, founded April 19, 1930, (Inactive).

ALPHA ETA

Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma, founded March 13, 1930.

ALPHA THETA

State College of Washington, Pullman, Washington, founded May, 1930.

ALPHA IOTA

Bucknell University, Lewisburg, Pennsylvania, founded January 9, 1932.

ALPHA KAPPA

Hunter College, New York City, founded January 8, 1932.

ALPHA LAMBDA

University of Utah, Salt Lake City, Utah, founded February 13, 1932.

ALPHA MU

University and State College of Oregon, Eugene-Portland-Corvallis, Oregon, founded November 18, 1933.

ALPHA NU

University of New Mexico, Albuquerque, New Mexico, founded April 21, 1935.

ALPHA XI

Rhode Island State College, Kingston, Rhode Island, founded May 17, 1935.

ALPHA OMICRON

Marquette University, Milwaukee, Wisconsin, founded June 18, 1938.

Washington and Jefferson

HISTORY

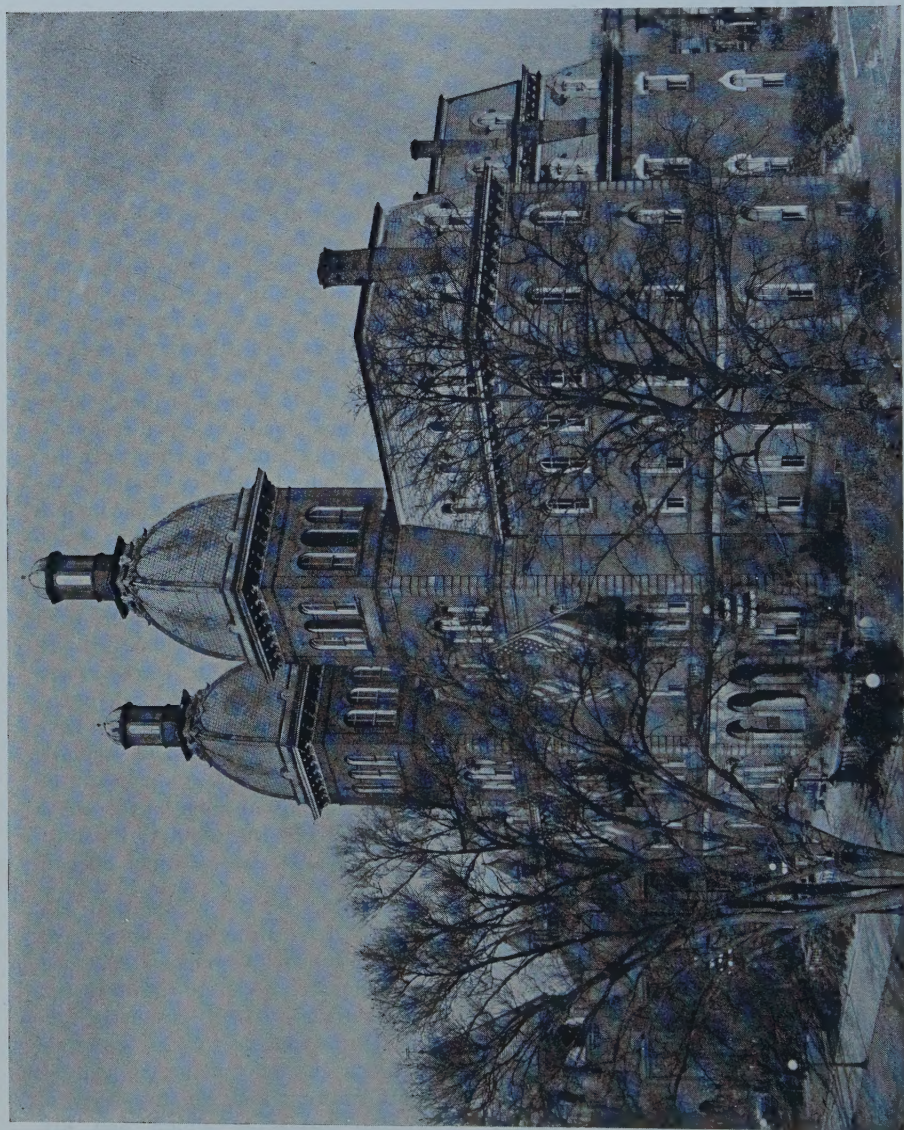
Washington and Jefferson College owes its origin to that belief in religious piety and sound learning which was characteristic of the pioneers and early settlers of this country. The colonists in New England erected a college within their first generation in America; the pioneers who in the next century pushed beyond the ramparts of the Alleghenies had a like devotion to the same ideals; and, even while they occupied log cabins and lived in fear of the depredations of the savages, they opened schools in order that an unlearned ministry might not grow up among them.

Two Presbyterian clergymen and educators, both Princeton graduates, played an especially important part in the movement, the Rev. John McMillan and the Rev. Thaddeus Dod. Dr. McMillan began his work in Western Pennsylvania in 1780, at which time he began his classical teaching. At about the same time Dr. Dod also began work toward the establishment of an academy. Classes were held in log cabins and instruction was given in English, the classics, and mathematics.

Washington Academy, which in 1806 became Washington College, was chartered in 1787. In 1794 the Academy at Canonsburg, which eight years later became Jefferson College, was founded. The academies were educational allies, rather than rivals; but as they grew and their scope of activity expanded, a distinct rivalry grew up between the two colleges and served to block the progress of both.

Time and again suggestions were put forward for effecting a union of the two colleges, each of which, even in the days of greatest prosperity, was a small institution. In the services which it rendered to the community and the Church, in the character of its professors, and in the achievements of its alumni, each of the two colleges exemplified the truth of the saying that "a university is builded of men." However, the inadequate financial resources of the institutions, together with the decline in the number of students due to the Civil War, which took particularly heavy toll of the enrollment of Jefferson College, presented grave difficulties. In September 1864 alumni of the two schools urged their boards of trustees to unite the two institutions. Six months later the legislature granted a charter for the united college; the Rev. Charles C. Beatty gave the college fifty thousand dollars, which he had promised on condition that the two institutions unite; and a new chapter in the history of education in western Pennsylvania opened.

The united college was moved subsequently to Washington, where it has since continued its great work of preparing men for all of the professions. Buildings were added gradually, but the main emphasis of the college's work was placed on thorough intellectual training and the necessity of Christian character which had distinguished Jefferson College and Washington College from their beginning. New endowments, new buildings, and increased facilities for work did not



Main Building.

cause Washington and Jefferson College to lose sight of the same high ideals.

Although the separate colleges sent a large proportion of their graduates into the ministry in the early years, the College today prepares men for entrance to schools of medicine, law, business, engineering, and many other types of graduate schools. Its long list of prominent alumni numbers hundreds of eminent and successful doctors and scientists.

PIONEER SCIENTISTS

Washington and Jefferson College has made a notable contribution to science in Pennsylvania, extending over a period of 130 years. The groundwork for scientific effort in Washington County was laid in Jefferson College. Here, as early as 1806, chemistry was taught; indeed, only ten colleges in the United States taught chemistry at an earlier date, and thirteen more years elapsed before chemistry was first taught in Pittsburgh.

So keen was the enthusiasm for science at old Jefferson that what was very probably the first student science club west of the Allegheny Mountains, was founded in 1831. This club, termed the "Lyceum of Natural Science of Jefferson College," held meetings, bought scientific journals and apparatus, and conducted experiments. The rising tide of the Civil War which so depleted the student body of Jefferson College, caused the Lyceum to terminate its activities, and the minutes end with the meeting of January 14, 1861.

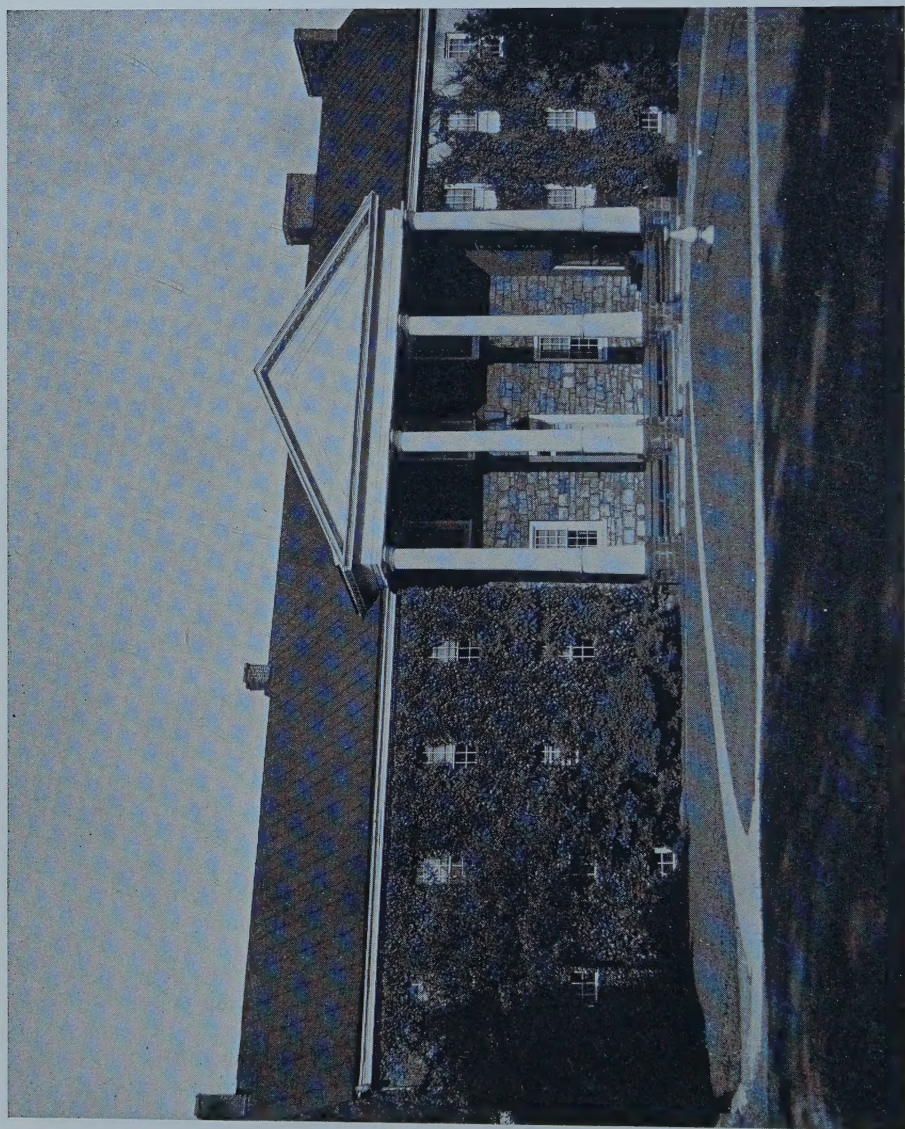
Almost from the beginning of scientific instruction in Jefferson College, a progression of inspiring teachers has marched down the years with the eager young men who had their early training in the colleges of Washington and

Jefferson. In 1828, the administration of Jefferson College brought to the campus at Canonsburg one Jacob Green, M. D., to give a course of chemistry lectures in the summer terms. Green was professor of chemistry and pharmacy at the newly founded Jefferson Medical College in Philadelphia, and was the author of six scientific text books on chemistry, electricity, and medicine. He was also the prime mover and founder of the Lyceum of Natural Science.

The years 1852-1878 were noteworthy in a scientific sense because during this period scientific training was in the hands of Dr. Samuel Jones. His was a giant intellect. Educated in the classics, a graduate of Trinity College, Dublin, Samuel Jones loved both the classics and the sciences and embellished each by illustrations from the other. He was an example, rare in American colleges, of the transition period of the history of the sciences, for he was one of those whose education connected two great realms of endeavor. Let anyone begin a quotation from the Iliad and Samuel Jones would complete the quotation in the Greek. Professor of natural science in Jefferson College, he became professor of the sciences at the union of the two colleges in 1865.

When Samuel Jones was called from his labors in this life, his work devolved upon a former student, Dr. James Ray, who taught the physical sciences from 1885-1910. Ray had been a student in Germany where he was a laboratory assistant to Kirchhoff, co-inventor of the spectroscope.

Meanwhile, in 1882, Dr. Edwin Linton, world-famous parasitologist, had commenced his teaching in biology which he continued until 1920. In 1901, Robert Kennedy Duncan, founder of the Mellon Institute, took over direction of



Administration Building built in 1793.

the newly-founded department of chemistry which had been split off from the physics department, and he taught here until 1905.

Thus, for a period of sixty years, students were trained under four outstanding teachers of science.

PIONEER SCIENTIFIC EFFORTS

The first really scientifically trained person to practice in the vicinity of the colleges was Jean Julius LeMoyne de Villiers, a refugee from the terrors of the French Revolution. His father had been a botanist of the first rank and was curator of the royal botanical gardens under the kings of France. LeMoyne (having since dropped the "de Villiers"), in 1797 set up in the infant city of Washington the first pharmacy west of the Alleghenies. His education had included seven years of study in medicine in Paris. Jean Julius LeMoyne was the father of the pioneer cremationist of the United States, Francis Julius LeMoyne.

Francis Julius LeMoyne possessed a highly scientific mind. A graduate of Washington College in the class of 1815, he received his M. D. from the University of Pennsylvania in 1823. In 1876 he built the first crematory for the disposal of the human cadaver in the United States. In the little brick building, still carefully preserved atop a hill near W. & J. College, LeMoyne, in the face of majority opposition carried out the first formal cremation in the United States on December 6, 1876.

LeMoyne was also interested in agriculture, and his interest led him to the scientific breeding of fine farm stock. His agricultural interest led him to endow the chair of biology at Washington and Jefferson College; that chair is currently filled by Dr. C. D. Dieter, present head of the department. It is interesting to note that the chair of biology was originally

called the LeMoyne Chair of Agriculture and Correlative Branches.

CONTRIBUTIONS TO MEDICINE AND BIOLOGY

The contributions of the college to medicine, biology, and hygiene have been continuous for over a century. An outstanding feature of this service was the founding of one of the leading medical colleges in the United States. In 1824, a group of medical men in Philadelphia petitioned Jefferson College to set up a department of medicine in that city. Medical degrees were granted to graduates of the department by the Board of Trustees of Jefferson College until the year 1838 when it obtained its own charter as Jefferson Medical College.

A similar arrangement was made by the Board with the medical school in Baltimore, known then as Washington Medical College because its degrees were granted by the Board of Trustees of Washington College. A group of physicians established a school in Baltimore to instruct young men in medicine, but having no charter to grant medical degrees, recommended to the board of Washington College those men who had completed its prescribed course and the degree was conferred by the board.

Medical graduates of the colleges have been pioneers and leaders in the profession. They have held offices of national importance which have included the following:

- L. S. Joynes, M. D., graduate of Washington College, president of the American Medical Association.
- R. Stanbury Suttorn, M. D., Jefferson '62, president of the American Academy of Medicine.

James King, M. D., professor of physiology in Washington College (1864-1869), a vice-president of the American Gynecological Society.



Jesse W. Lazar Chemistry Hall.

Robert M. S. Jackson, M. D., Jefferson 1834, the Civil War Surgeon General.

Clement A. Finley, M. D., Washington '15, a Surgeon General of the United States Army.

John Campbell, Jefferson '47, Chief Medical Officer of the United States Bureau of Pensions.

Dr. R. Stanbury Suttorn was the first surgeon in the United States to successfully remove a section of the intestine, and Ebenezer Jennings, who attended Washington College, was the first doctor to introduce vaccination into Western Pennsylvania, probably within a decade after Jenner's epoch discovery.



DR. J. W. LAZEAR

A bright chapter in this story is the part which has been played by W. & J. men in achievements of the United States Public Health Service. Thus, Dr. Jesse W. Lazear, '88, who as a member of the United States Army Yellow

Fever Commission, gave his life in that service, was credited by Dr. Walter Reed with the discovery of the yellow fever mosquito. The work of Dr. John D. Long, '94, who became Assistant Surgeon General of the U. S. Public Health Service in 1910, has been outstanding.

The most eminent of these service doctors, however, was Dr. William B. Wherry, '97, world famous bacteriologist. His public career was spent with the United States Public Health Service in the Philippines, the Oakland Bay region in California, Kentucky, and Mexico. His researches were published

in eighty-two scientific papers. Wherry was the discoverer of the bacillus of tularemia and the bacillus of rat leprosy. He was pioneer in recognizing the microaerophile bacteria, and in demonstrating that variations in microorganisms are inducible through changes in environment. He was also an authority on immunization, and for twenty-five years (1909-1936) he was a member of the faculty of the Medical School of the University of Cincinnati.

DR. JOHN D. LONG

Dr. John D. Long, an honorary member of Nu Chapter, has had a long and distinguished career in the United States Public Health Service. He advanced from the post of an assistant surgeon in 1900 to Assistant Surgeon General in 1910-12 and 1921-25 to Medical Director in 1930. At various times he has been director of health in Manila, professor of hygiene at the University of the Philippines, chief quarantine officer of the Philippines, and is responsible for the reorganization of the Philippine Health Service.

He was loaned by the United States government as a technical adviser in public health to the Ministry of Hygiene of the Republic of Chile for the reorganization of the Chilean National Health Service in 1925-26. The following year, he became chief quarantine officer for the Panama Canal Zone. He served as technical adviser to many South American and Latin American conferences on Sanitation and Public Health, and for some years served as the traveling representative of the Pan-American Sanitary Bureau.

Ecuador, Peru, Chile, Argentina, and Brazil have all called upon him to be technical adviser in their campaigns against bubonic plague. He has been decorated with the Al Merito of Chile



McHattie Memorial Hall (Biology Building).

and Ecuador, the Order of Carlos Finlay of Cuba, and El Sol, Peru.

DR. EDWIN LINTON

Of the non-medical biology men, Professor Edwin Linton, attained world-wide recognition as a parasitologist, particularly in the field of ichthyology. In Volume XVI, No. 2, of the *BIOLOGIST*, 1935, is the story of Dr. Linton's experiences as he recorded them. In that article he preferred to be referred to as a "helminthologist," one who studies worms, especially parasitic worms. Whatever the proper title, he brought honor to his alma mater, from which he was graduated in 1879.

He began to teach at W. & J. in 1882 and labored here for a period of thirty-eight years. During his tenure here, he was a member of the United States Fish Commission for twenty-six years and did summer field work at Wood's Hole, Mass., Yellowstone, Beaufort, N. C., Bermuda, and the Tortugas in the Caribbean.

Every member of Phi Sigma who ever worked at the Marine Biological Laboratory at Wood's Hole during the summers of Dr. Linton's lifetime well remembers him. His presence and his personality were inspirational to many young biologists struggling to make successful research for the first time.

From his laboratory there flowed more than a hundred scientific papers—all of them the results of thorough investigation, accurate observation and written carefully and in readable style. His first scientific papers were concerned with a trematode identified as *Distomum ovatum Rudolphi*, found in the albumen of a hen's egg, and the other on two forms of cestode embryos.

Nearly one hundred of his papers are helminthological and cover the whole field of verminous parasites of fishes and birds. About thirty deal with the adult cestodes of sharks, a

smaller number with those of birds and both adult and larval cestodes of small fishes, and a still smaller number with trematodes. The remainder are made up of an occasional paper on nematodes, Acanthocephali and even on protozoan parasites of fishes, the food of fishes, and the habits of fishes.

Dr. Linton's work provided a valuable store of facts relating to anatomy, host-parasite relations, ecology and life histories, which are all useful to future taxonomists. In his lifetime, he was honored by the award of two medals (one of which was the Leidy Medal of the Philadelphia Academy of Natural Science), election to a foreign correspondence, and other honors.

Through the income from an endowment established by Dr. Linton, Phi Sigma members of Nu chapter are privileged to spend summers at Wood's Hole in research work. Formerly, at least two men were awarded this summer scholarship. Since Dr. Linton's death, Mrs. Linton generously contributed an additional sum which will enable at least two more students to visit Wood's Hole each summer.

Washington and Jefferson named its new zoological laboratory the "Linton Memorial Laboratory" in his honor.

PRE-MEDICAL PREPARATION

Washington and Jefferson College is essentially a pre-professional school. Its graduates go on to higher institutions each year and branch out into all of the various professional fields. Foremost among its departments is the Biology Department, which, in the past fifteen years, has sent an ever-increasing number of its graduates to medical schools throughout the country. Their records in medical school and their subsequent success in their chosen field is excellent testimony to the type of training they have received in the College.



Thompson Memorial Library.

Recently, Dr. Dieter, head of the Biology Department, set forth the ideals of the department in a brochure intended for men who desired to obtain pre-medical training at W. & J. It is entitled "What It Means to be a Doctor" and excerpts are given below:

"The physician," said Hippocrates, "must know a man's nature and a man's behavior through life in relation to all his actions."

MORAL AND INTELLECTUAL INTEGRITY

Absolute honesty is essential in every relationship without regard to its effect upon one's own personal fate. This together with moral integrity manifested in every opportunity to be helpful in social and civil life should be evident in the doctor's every opinion, motive and action.

PERSONALITY AND SCHOLARSHIP

A doctor's first qualification is to be a gentleman imbued with the desire to serve and make others happy as well as to achieve happiness for himself. Facts can be taught, succession of events can be explained, but judgment cannot be instilled. It is the personal product of long training and masterful scholarship. A doctor must exercise skillful judgment from instant to instant, depending upon his findings.

THE URGE TO INQUIRE

The doctor must have "intellectual curiosity," that is, a searching inquisitive nature, a longing for the acquisition of knowledge, an eagerness for discovering, and an everlasting curiosity concerning that most complex of God's handiwork, the human being.

OPTIMISM, COURAGE AND FLEXIBILITY

Battles with disease and death must be fought with composure, inexhaustible patience and optimism. Confidence must be manifest in every gesture, for no man benefits his patient if he appears apprehensive and uncertain.

The doctor must be willing to change his opinion, or his diagnosis, or his methods of treatment when developments warrant or the exposure of others shows the need of a change. In other words, although determined and persevering, he must be flexible. He must have the ability to work in harmony with superiors, equals and those under his supervision. This means the capacity to participate in teamwork and the ability to measure up to responsibility when working alone as well as when working under the observations of others.

MONEY A SECONDARY CONSIDERATION

A young man's desire should be love of his work. He cannot be a real physician unless he chooses his profession for the good he can do rather than for the goods he can acquire.

Washington and Jefferson College maintains that success in any profession is basically the proper training of mind and character. This kind of training enables an individual to live with himself and his fellowmen. Without excellent qualities of character and mind an individual is doomed to failure regardless of technical knowledge and professional skill. The pre-medical student is offered the fundamental preparation for his later specialized professional training. Such a two-fold undergraduate program is an ideal preparation for the medical profession.

The College has had a complete and thorough pre-medical course for many decades. The first physician alumnus was a member of the class of 1804 and since that time over one thousand physicians have completed their pre-medical training. This record of achievement can only mean that a thoroughly competent course has been developed.

Pre-medical men in the senior years



Gymnasium Tower.

average about twenty students. Having a group of such moderate size, we are able to be of much assistance to the individual student in planning his courses, in obtaining admission to the medical school of his choice and in making possibilities for success much greater. Graduates are to be found at the present time at Harvard, Western Reserve, University of Pennsylvania, Cornell, University of Pittsburgh, Jefferson, Chicago, University of Maryland, Hahnemann, and other leading medical schools. A recent report from the Association of American Medical Colleges shows that during a ten-year period medical graduates of W. & J. have maintained a ninety per cent average of successful graduation from their respective medical schools.

The courses offered meet the requirements of any of the medical schools. The schedule offers opportunity for the inclusion of liberal arts subjects so essential to a broad, liberal education. The student takes all of his work under the direct supervision of the heads of departments, as well as a considerable part of the work of the first years, especially in the laboratory sciences. Every instructor in these departments has received his doctor's degree, so the student is assured of excellent instruction in the departments which have a direct connection with the work of the medical school.

At this College a pre-medical committee advises, helps and recommends the pre-medical student. The system is unique in that the committee sends a composite recommendation for each student applying for entrance to medical school. These recommendations embrace the opinions of the professors from several departments in which the student has done a great deal of his work. This system obviates the fallacies of many divergent and conflict-

ing opinions which in many cases work to the disadvantage of the student.

DEPARTMENTAL EQUIPMENT

The Biology department is housed in McIlvaine Hall, where thirty rooms are provided for the teaching of biology and all its* branches. The building is located on the new south campus of the college, which was completed last fall. The building was completely remodeled, both on the interior and exterior and now has rooms and laboratories devoted to the teaching of zoology, botany, comparative anatomy, embryology, histology, physiology, bacteriology, genetics, evolution, and geology. Ample store rooms, preparation rooms and a dark room, as well as culture rooms are to be found here.

The animal house and the laboratory for comparative anatomy is located on the ground floor. For the teaching of comparative anatomy, this laboratory is well supplied with skeletons of vertebrates, preserved materials and models. The lecture rooms and offices are located on the first floor.

One lecture room is large enough to seat seventy-five students and it is supplied with museum cases in which are to be found type specimens of the animal kingdom from protozoa to mammals. In this lecture room are located two chart cases containing more than two hundred charts dealing with animal and plant biology. The N. Y. A. students have helped to build up this fine chart collection.

The entire second and third floors are taken over for laboratories for botany, zoology, bacteriology, physiology and special rooms for advanced undergraduates and graduate students. On the second floor is located also a large room for the departmental library. This library contains a very fine collection of reprints from the



McIlvaine Memorial Hall (Biology Dept.).

various fields of zoology obtained from Dr. Edwin Linton through his extensive exchange courtesies with other scientific workers.

Of special interest on the third floor is the Linton Memorial Laboratory, furnished and equipped in honor of Dr. Edwin Linton, whose portrait hangs in a prominent place in the laboratory and whose inspiration will always be a living memory to the staff and to the students studying in that room.

On the third floor are rooms for the advanced students, special store rooms, and a dark room. The Biology laboratory of Washington and Jefferson College is particularly well-equipped with demonstration and museum material confined to cases in the hallways of

the second and third floors of McIlvaine Hall. This material was acquired largely because of the ability and enthusiasm of Dr. Linton as a collector. His association for many years with the United States Fish Commission brought him in contact with the fauna and flora of all parts of the world. Many biological and geological specimens were brought back to the College by him with his return to his teaching and research at the College. In the basement of the building are to be found casts of ancient reptiles and mammals which he purchased from various city and county fairs. In the botany laboratory is to be found a very excellent nucleus for an herbarium. Some of this material deals with the local flora, but a great deal of it was

obtained from the Carnegie Museum by exchange made possible by Dr. O. E. Jennings.



Main Building.

NU CHAPTER OF PHI SIGMA

Nu chapter of Phi Sigma was granted a charter on April 19, 1922. Previous to that time, the biology department had sponsored the "Darwinian Society" under the leadership of Dr. Norman M. Grier, professor of Biology at that time.

Since the charter was granted, Nu chapter has held meetings regularly every two weeks during the academic year. The chapter now has 200 alumni members, 3 active faculty members, and 12 active undergraduate members. In 1942, the chapter will fittingly cele-

brate the 20th anniversary of the granting of its charter and plans for that event are now under way.

Among the many service projects the chapter has performed for the Biology Department and the College were the Biology Department's open house in 1934 and entertainment of the annual meeting of the Pennsylvania Academy of Science in 1940. Last March, the chapter joined with the Washington County Medical Society for an open meeting at which a member of the research staff of the West Penn Hospital in Pittsburgh was the main speaker. "Pathology" was the subject of the discussion.

Honorary members of the fraternity are outstanding men in several fields:

Honorable Gifford Pinchot, former Governor of Pennsylvania and a pioneer in forestry conservation, is one of the first honorary members elected.

The late Professor A. E. Ortmann, curator of Invertebrates at the Carnegie Museum in Pittsburgh, and an outstanding animal geographer, was an honorary member.

Dr. O. E. Jennings, curator of herbarium of the Carnegie Museum, and Professor of Biology at the University of Pittsburgh, is an honorary member.

One of the founders and chief supporters of the Eugenics Record Office at Cold Springs Harbor, Dr. Charles B. Davenport, holds honorary membership in Nu chapter.

Other outstanding honorary members of the chapter included the late Dr. William J. Holland, former director of Carnegie Museum; the late Dr. Edwin Linton, outstanding parasitologist; and the late Father Julius A. Nieuwland, chemist and Biologist at Notre Dame.

Dr. J. D. Long, of the United States Public Health Service, a graduate of W. & J. and Dr. Edward M. Weyer,

professor of Philosophy and Dean of the Faculty at W. & J., are also honorary members.

DEPARTMENTAL STAFF

The staff of the Department of Biology at Washington and Jefferson College is headed by Dr. C. D. Dieter, who has been a member of the faculty since 1922. His assistants are Dr. Homer C. Porter and Professor B. George Osterman. All are members of Phi Sigma and of Nu chapter.

Dr. Dieter has been head of the Biology Department since 1935. Six years previous to that time he was acting head of the department following the resignation of Dr. George W. Martin. Dr. Dieter was graduated from the University of Pittsburgh, studied for his Master's degree at W. & J., and received the Doctor of Philosophy degree from Pitt in 1934. He has done work towards his medical degree at the University of Chicago.

For many years, Dr. Dieter has been chief advisor to Nu chapter of Phi Sigma and it was due to his efforts in the early history of the chapter, that it attained a firm hold as one of the leading honoraries on the W. & J. campus. Dr. Dieter is head of the Medical Service of the College and is chairman of the Pre-medical Advisory Committee. He has been at the Marine Biological Laboratory for at least two summers and has done research work in the field of Zoology. He is also the author of numerous scientific treatises which have appeared in several leading publications. He is a member of the American Association for the Advancement of Science and of Sigma

Xi. He is listed in the *American Men of Science*, 5th edition.

Dr. Homer C. Porter, assistant professor of Biology, is a graduate of Washington and Jefferson in the class of 1926 and was graduated Magna Cum Laude. He served the College for three years as a fellow in Biology and received his Master's degree in 1929. At that time he was made an instructor in Biology and Geology.

He was admitted to the graduate school at the University of Pittsburgh in 1932 and specialized in Zoology. His thesis work was concerned with "The Experimental Investigation into the Musculature of Triturus." He spent the summer of 1934 in the Marine Biological Laboratory studying the embryology of the marine invertebrates of the Cape Cod region. He is a member of Phi Sigma, the Pennsylvania and West Virginia academies of science, and an associate in Sigma Xi.

The third member of the department, Mr. B. George Osterman, was graduated from W. & J. in 1933 and attained his Master of Science degree there in 1935. He was a graduate assistant at N. Y. U. from 1935 to 1939, where he did work towards his doctor's degree. He teaches Physiology at Washington and Jefferson at the present time. Mr. Osterman has majored in Invertebrate Zoology at N. Y. U.

These three members of the department constitute the Washington and Jefferson faculty committee on pre-medical preparation. Their long hours of devoted service to the department have shown great results in the records of their students who have gone on to medical and graduate schools.



Research with Colchicine in Retrospect

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Five years ago this month, in March, 1937, I observed the polyploidizing effects of colchicine upon meristematic cells of onion root tips. Onion roots which had been placed in a two-tenths per cent aqueous solution of colchicine developed thick bulbous tips. These tips were composed of enlarged cells filled with many chromosomes. Many of these cells contained as many as 64 chromosomes. Did this drug induce polyploidy in the cells of onion roots? If so, how might the use of this chemical be applied to other plants and plant parts? Radish, corn, and wheat seedlings placed on filter paper saturated with colchicine showed cell reactions of the hypocotyl similar to those of the roots of onion (9).

I recall discussing with workers at the Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, Long Island, New York, the effects of colchicine upon plant cells. Certain discussions concerning the application of these facts to the problems of plant breeding were with Doctors B. M. and Helen Slizynski, then International Rockefeller Fellows from Krakow, Poland; at present these friends and fellow scientists are war refugees in Great Britain.

Before the close of that year 1937, the possibilities of colchicine appeared to be more than a mere prediction, because data obtained had shown its

effectiveness as a polyploidizing agent (2), (19), (26), (27), (28).

Two important results from the use of this method attracted the interest of plant breeders, namely: the possibility of now inducing polyploidy in sterile hybrids which would render them fertile and useful for further studies; and the production of polyploids made it possible to hybridize and select on a much larger scale.

The student of evolution was interested in this drug because of the possibility of duplicating species formation by this method. Sterile species hybrids could be changed to fertile plants which differed markedly from either parent. Furthermore, polyploidy characterized one-half the existing species of flowering plants in which chromosome numbers have been counted (25).

The amateur and professional were interested in this method because of the direct advantages of polyploids over the diploids with regard to size of leaf, stem, fruit, flower, and seed. Also, polyploid plants often are more vigorous and are more disease and drought resistant than diploid plants of the species.

Thus, colchicine attracted the attention of a great number of individuals in various branches of plant science, viz., plant breeders, students of evolution, and amateur and professional botanists.

The suggestion for work with colchicine and plants came from my colleague, Mr. E. L. Lahr, of the Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, Long Island, New York, who had been experimenting with the effects of colchicine upon animal tissue. Similar experiments with plants were carried on independently in other laboratories; each of these scientists received suggestions for work from a different source. However, all suggestions ultimately came from the research of Professor A. P. Dustin and his associates who were studying the effect of colchicine upon animal tissue (8), (9), (19), (20), (23), (28).

The events preceding the successful use of colchicine upon plants prompted three different historical accounts regarding the transfer of ideas and suggestions from one scientist to another. The first account was described in the paper entitled "The Colchicine Fad" (47). A second account was reported as a colchicine chronology (20). Finally, the third summary is found in the recent botanical review on the subject, "Colchicine polyploidy and technique" (5). Each of these historical summaries are accurate accounts of the events that transpired during the period of development of the colchicine technique for induction of polyploidy in plants.

A study of these historical accounts relegates priority to a position of secondary importance. It is evident that a scientist cannot be isolated from his fellow scientists, and the scientists of one nation cannot be isolated from the scientists of another, if progress is to be expected. Collaboration is of greater importance than priority. Achievements and advancements are made by the combined suggestions, criticisms, and ideas contributed by numerous in-

dividuals. This can be accomplished by publication or through discussions of ideas and experimental procedures.

The present paper on this fifth anniversary of my experiments with onion roots is in retrospect. It is not my aim to give a critical review and evaluation of all the published work. This would involve a discussion of more than two hundred papers on this subject. Such presentation would duplicate the existing review on this subject (5). Rather, I should like to trace three phases of the development of colchicine research with plants during the past four years. These phases are: first, the cytological basis; second, methods of application; and third, colchicine as a tool for amateur and professional botanists and plant breeders.

CYTOLOGICAL BASIS FOR THE ACTION OF COLCHICINE

Researches with animal tissue treated with colchicine showed that cell division stopped and mitotic figures accumulated, especially metaphasic stages. Further investigation disclosed that colchicine prevented cell formation, but the formation of new chromosomes continued. The chromosomes are scattered in the cytoplasm in the presence of colchicine; consequently, the chromosomes are not separated equationally into two cells. In some manner spindle-fiber formation is inhibited. If cells are removed from the influence of colchicine, the usual mitotic process occurs. Briefly, the presence of colchicine prevents cell formation but does not prevent chromosomal division. Consequently, the total number of chromosomes which usually separate into two cells remain in one cell, hence the number of chromosomes is doubled in the treated cell (2), (4), (8), (9), (10), (11), (12), (16), (19),

(22), (23), (26), (27), (28), (30), (34), (41), (45), (46), (48).

Physiologically, the effect of colchicine upon cell behaviour is not well understood at the present time. Most facts relative to the influence of colchicine are those established by morphological studies. It is believed that colchicine influences the activity of hormones (19), (20). Recent experiments indicate that colchicine influences the speed of enzymatic reactions (44).

METHODS OF APPLYING THE DRUG

When it was known that dividing cells were effected by the action of the drug, techniques were devised to subject actively dividing cells to the influence of colchicine. Such regions of actively dividing cells are known as the meristem of plants. If seed, seedling, or the mature plant is treated, the ultimate goal is to subject dividing cells to the colchicine directly.

Several methods were devised which presently served as the basis for most experimental work (3), (27), (28), (33). Certain modifications with regard to length of time for treatment and concentration of solutions have been made. Plants respond differently to the treatment. For instance, the same treatment effective for *Petunia* is not equally effective for sugar beets (32).

Colchicine in an aqueous solution can be used for seed treatments prior to planting, or for the growing portions of plants, i.e., the meristem can be immersed in the solution for varied lengths of time. An effective range of concentration is from a 0.1% to 0.4% solution. The time of treatment is variable, from 24 hours to 6 days, depending upon the material.

The powdered colchicine mixed with lanolin or mixed in a salve-like base

can be smeared over the growing portion of the plant. If the preparation is in the form of an oil emulsion, such can be sprayed or brushed over the growing parts of plants. Elaborate details of the application of this drug are found in the original papers on methods or from a review on the subject of colchicine polyploidy and technique (3), (5), (28), (29), (34).

Frequent questions are asked about colchicine. What is colchicine? How can it be procured? How much is necessary? Is it similar to vitamin B₁ and chemicals used in soilless gardening? Colchicine is a very poisonous alkaloid, obtained from the underground part of the autumn crocus, *Colchicum autumnale*. Physicians have used it as a remedy for gout and rheumatism for many years. It may be purchased from Merck and Company, Rahway, New Jersey, at about \$1.75 per gram. One gram will treat many plants. This gram if dissolved in a pint of water gives a strong solution and can be used in a preliminary series of treatments. If necessary, dilute this master solution with water. The General Biological Supply House, 761 East 69th Place, Chicago, Illinois, distributes a preparation of colchicine in an emulsion which we find very effective in the production of polyploids in periwinkle. Also, the Cambridge Laboratories at Wellesley, Massachusetts, distributes a preparation called "colchisalve," which we have found to be an effective mixture. These commercial preparations are effective and suitable for anyone interested in such experiments. Experimenters must regard this substance as very poisonous and dangerous if handled carelessly. Care must be taken to keep it from children. This type of chemical used in plant experiments should not be confused with chemicals of soilless gardening, vitamins, or

hormones. Colchicine is used to develop mutations and once a plant is treated successfully, no further applications are necessary as in the case of fertilizers or chemicals. Colchicine influences changes of hereditary nature, whereas other substances influence the physiological phases of only the treated generation.

INDUCTION OF POLYPOIDS BY AMATEUR AND PROFESSIONAL

The application of colchicine is relatively simple. Most non-technically trained students in botany classes at the University of Oklahoma have used the drug successfully. A cooperative research project was planned for persons interested in treating various kinds of plants. Colchicine was mixed with lanolin and placed in small one dram vials. Amateurs were furnished with a set of directions, the drug, and a questionnaire for reporting results. Seeds or cuttings of treated plants were to be sent to the laboratory for verification and further tests.

The project was planned for 100 persons. This number was reached early in 1940. Later 200, then 300, and now more than 500 persons are interested in such experiments. Amateur scientists from all over the United States, including every state except six, and foreign countries, including Canada, Mexico, Sumatra, South Africa, and Australia are enrolled in the project. This response shows that numerous individuals are interested in experimenting with plants. The value of the project is one of educational opportunity and of possible economic significance when new and important plant types are developed. The supervision of tests with new types is the responsibility of trained workers in our laboratory. The exact value of colchicine as an aid in gardening prac-

tices can not be estimated with the present data.

The results of this first hundred experimenters are interesting. This group includes people engaged in 15 different occupations; none is a trained botanist. Twenty of this first group secured new plant types. One person, a nurse, succeeded beyond my most optimistic expectation. A treated soy bean plant showed the characteristics of a polyploid. This plant produced seed that weighed twice as much as seed from the control plant, and produced seeds twice as large as the control. A number of others were highly successful in their experiments. Each person has voiced an interest in future work for 1941—even those who failed. The failure in some cases was not caused by the colchicine treatment but by various accidents in cultivation of the plants. A lanolin base is not the best method for colchicine applications but is suited for our particular problem.

The data from this cooperative project show that colchicine is an effective tool in the hands of amateurs. It can be used by those not highly trained in technical work. However, it cannot be concluded that colchicine in the hands of an amateur is of economic value from the standpoint of an aid in gardening practice. One can expect a few individuals to continue studies in hybridization and selection which logically follow successful treatment with colchicine. Among those cooperating, already some have shown ability for careful accurate work. Individuals who thought colchicine was magic have been duly educated in the realities of the possibilities of this drug.

Technically trained botanists have used the drug successfully during the past four years. One hundred and ten different species have been polyploid-

ized by colchicine according to one record (17). This list is longer today because new plants are being developed constantly. The records from our laboratory and others include 125 different species polyploidized to date. Comments on all these cases would be too extensive. Therefore, only representative cases which present evidence of the valuable aid furnished by the use of colchicine will be used in this discussion of the induced polyploidy and its part in the program of plant breeding.

Tobacco has been studied for some time with regard to problems of polyploidy. Recently, colchicine is being used as the agent for induction of polyploidy. Eighteen polyploid plants were obtained from 131 plants treated with colchicine in one series of experiments (43). This drug is useful in the production of polyploid plants. This technique makes it possible to produce fertile species hybrids.

The development of disease resistant plants in cultivated tobacco might be realized by species hybridization and subsequent induction of polyploidy in the hybrids. In this manner increase in nicotine content and anabasine content of certain strains of tobacco might be had. The direct advantages of polyploids without hybridization in tobacco are questionable. The drug is essentially a tool for future plant breeding programs. However, the use of this tool might yield results of direct economic importance (43).

Eleven types of cotton have been polyploidized with colchicine. In this group some contain four sets of chromosomes, (tetraploid), some six (hexaploid), and others eight (octoploid). In these resulting polyploid types sterility is the distinct limitation in further cotton breeding work. However, through further plant breeding

the genetic material of one species can be transferred to another and thus better cotton can be expected than is presently available. Genetic material of wild species of cotton when combined into polyploids of the cultivated types yields new types of fibers. Further promising possibilities in polyploids are the development of disease and insect resistant plants. Also growth habits of cotton may be altered. Usually the polyploids from sterile hybrids between distantly related types are fertile (1).

A decided increase in the seed size of buckwheat has been attained by the induction of polyploidy in this species. As high as 25 percent more seeds are present in polyploid buckwheat than in the original untreated parent. Furthermore, the weight of the seed, endosperm embryo, and hull of the polyploids is 41, 15, and 63 percent greater, respectively than those of the control plants. Other characteristics such as anthocyanin content, hairs, and general plant characters are accentuated in the polyploid types. The full meaning of an increase in seed size and production in the new plant remains to be determined by further testing under field conditions (36).

A practically sterile hybrid of basil (*Ocimum canum* X *O. gratissimum*) which had been propagated by cuttings became fertile after colchicine treatment. The new polyploid type (amphidiploid) in addition to setting fruits has larger flowers than the sterile plant. Also, the leaves are larger and the distance between flowers on the axis of the inflorescence is farther apart in the polyploid. The eugenol-bearing hybrid basil now can be reproduced by fruits instead of cuttings (21).

Since 1931 mint hybrids have been propagated at the New York Agri-

cultural Experiment Station. One of these is a cross between *Mentha aquatica* and *Mentha rotundifolia* (Ruttle, 1932). When runners and young shoots of this hybrid were treated with colchicine, polyploid shoots (amphidiploid) developed. The resulting polyploid hybrid plants are more vigorous, the leaves and flower spikes are larger, and the plants produce viable seed. A difference in odor of the new plants compared to the odor of untreated plants is of interest. The odor of the new mint polyploid hybrid is distinctly more "minty" than the original hybrid. This shows that physiological as well as morphological features are influenced by the increase in chromosome number (34).

The direct advantage of increase in size of plants has been realized in a number of different types of flowers. Some striking giant types of Marigold, Zinnia, Lily, Cosmos, Phlox, Snapdragon, Periwinkle, Petunia, etc., are now available from colchicine-treated plants (5), (6), (7), (14), (15), (17), (18), (21), (24), (28), (29), (31), (33), (34), (35), (36), (38), (39), (40), (42), (43), (46), (48). Not all plants respond to this treatment. Furthermore, many of the present day cultivated plants already have doubled, tripled, quadrupled, and even greater increased in chromosome numbers. These cultivated plants are not ideal for colchicine treatments if one is interested in securing new and better types. A limit is reached where further increase in chromosome number is no longer advantageous over the untreated plants.

Colchicine probably is useful in development of better types of fruits. Such work requires a longer time to produce results than the cases where annuals are being studied. A review of the chromosome numbers in apples, pears, and the various kinds of bram-

bles indicates that doubling of chromosome number has played a role in the differentiation of varieties (29).

Most raspberries have 14 chromosomes, but the increase to 21 or 28 brings about a change in the formation of flower buds on the current season's growth, a feature accentuated by the increase in chromosome number. The logan berry, and the Laxton berry are related to the blackberries and raspberries and have polyploid chromosome numbers (29).

Much work can be expected in those types where polyploidy does not exist, such as currants and gooseberries. Peaches treated with colchicine have been polyploidized but as yet no results are available as to the type of plant produced (6), (7), (29).

Since one-half the flowering plants known for chromosome numbers are polyploid, the evolutionary role of this type of change is of interest to students of evolution (25). In some cases the polyploidy results from a doubling of the chromosome number in diploid cells. A recent discovery of this type of increase is *Polygonatum commutatum* (great Solomon's seal). Another species is called the small Solomon's seal (*P. biflorum*). Gigantism is cursory evidence of polyploidy. Analysis of the chromosome number reveals that the large species contains 20 chromosomes (haploid) and the smaller species has 10 (haploid). Furthermore, these 20 large chromosomes appear in duplicate in the haploid number, whereas the species with 10 chromosomes do not show such duplication (13).

Sometimes different species accidentally hybridize in nature. Often this species hybrid is sterile but continues to grow vegetatively. If the chromosome number of such hybrid becomes doubled, the sterile hybrid changes into a

fertile plant and is thus distinguishable from either parent. A classical case of such hybrid is the accidental cross between two species of *Primula* at Kew, England, (*Primula verticillata* X *P. floribunda*). At first this hybrid was sterile but later produced a fertile branch. This fertile shoot was then propagated by seed as a pure breeding type and named *Primula kewensis*. A study of the chromosome numbers of this species, *P. kewensis*, and the two parents disclosed that the parents had nine pairs of chromosomes (18 chromosomes) and the fertile *P. kewensis* had twice the number of either parent or 18 pairs of chromosomes (36 chromosomes). A good many other cases in wild and cultivated forms were reported subsequent to the case of *P. kewensis*. A few of these are: wheat, oats, timothy, and tobacco, and even species of trees, such as the species related to horse chestnut. This evidence of origin of species in nature by doubling of the chromosomes had accumulated prior to the development of the colchicine technique. With the introduction of this technique, it appears that here is a method whereby man can duplicate certain of the processes which are going on in nature and of fundamental importance in the establishment of new species (25), (40), (43).

On this fifth anniversary, the information at hand conclusively proves the effectiveness of the drug, colchicine, as a polyploidizing agent. There is less evidence from amateurs of the effectiveness of its use than from professional botanists and plant breeders; however, the cooperative project has shown that the simplicity of the technique and the obvious results obtained in many plants make it possible to consider the drug a tool for amateur as well as professional.

These methods of inducing polyploidy with greater frequency than it occurs in nature culminate the search for such an agent for a period of several decades. Various agents and chemicals have been tried but no other has been used with the same volume of results as colchicine. Also, it must be remembered that certain other chemicals have yet to be tried and used as extensively as colchicine (4), (32), (37).

No accurate estimate of the economic value can be made of the plants produced from colchicine. It will be difficult to estimate its use in terms of economy to states and nations at any time. Without doubt the use of the drug has opened up greater opportunity for the development of new and better plants. The direct advantages of polyploids do not appear so promising as the future usefulness of the induced polyploids in a breeding program.

During the past four years attention has been paid to the establishment of the cytological facts, methods of application, and the characteristics of induced polyploids. The future will probably be one in which methods involving colchicine will be routine in the program of plant breeding.

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Human Heredity

LINCOLN CARTLEDGE, University of West Virginia
(Delivered at the Initiation Banquet of Alpha Epsilon Chapter)

It has been a long time since last I had the opportunity to meet with the Alpha Epsilon Chapter of Phi Sigma, and I scarcely need to tell you what a great pleasure it is to be with you again. I feel especially grateful to have been invited at the time of this initiation ceremony, since I am thus able both to visit with the members whom I knew when I was an active member of this chapter, and to greet the worthy and fortunate neophytes. Since they have been elected to membership in this group, all, I am sure, are worthy; and I know that all will find themselves fortunate in sharing the associations, the inspirations, and the duties which are the products of this peculiar symbiosis that is called Phi Sigma.

There is a saying that to err is human, and should the talk that I have prepared on the subject of human heredity seem to you to be very human indeed, I hope that you may recall and be guided by the remainder of this saying. The subject is one that should be of interest to all of us, for we are, after all—perhaps we should say, before all—human ourselves. After you have been in Phi Sigma for a while you will realize that this applies even to your professors. A biological audience knows that in the human species heredity follows the same general laws and exhibits the same types of behavior that it does in the lower forms of life. There are, however, a number of difficulties inherent in the study of heritable human traits. Most of them are due either to the nature of the

material, or to the nature of the investigator. The directed type of experimentation that has achieved considerable success in investigations on genetics of the lower forms is, for the human material, almost entirely ruled out. We must rely either upon statistical analyses of observations on population samples, or upon pedigree studies in families which happen to show evidences of segregation for some particular characters. The difficulty that most of us might find in assembling a comprehensive family pedigree is quite a real one, even without the additional necessity for the accurate tracing of some heritable character through the past generations as well as through the widespread present generation in its collateral lines. Every human individual represents the point of convergence of a number of ancestral lines, and rarely indeed can more than a few of these lines be traced. The limitations of both methods are such that we must not be surprised if only the clearest and simplest cases can thus be resolved, for solutions in cases which are genetically complex can scarcely be expected.

The investigators of human inheritance are human too, and it is very rarely that one possesses the interest and knowledge in all of the biological fields that may be needed for a satisfactory exploration and analysis of his case. Many excellent anatomical, physiological, and clinical studies show inadequacies and errors in their genetic analyses; and many studies

made from the genetic viewpoint exhibit lamentable ignorance in other directions. The incompleteness and lack of accuracy in the data available may easily lead to a less than wholly objective treatment of the genetic material.

There is one further difficulty which perhaps is often the limiting one for studies in human inheritance. It is simply the very ordinary one of locating sufficient human material under conditions in which the cooperation of the families concerned, which is very essential, may be secured. The family studies which I shall present have been obtained from students; at first as an exercise in the class-work in genetics, and then by further investigation of cases of interest. They represent a selection from the much larger number available, chosen for general interest, for novelty, or for unusual comprehensiveness. Most of the students work upon their own families, and are able to obtain the cooperation of other members to a degree that would perhaps not often be possible for an outsider. If I did not feel that I have in some part overcome this last difficulty, I would not have the temerity to talk on this subject before a group which includes so many who know more about the material than I do.

It is, of course, well known that many of the most important characters of humans have a well-defined hereditary basis, and that many of the more extreme types of physical, physiological, and mental defects have been shown to be rather simply inherited. There has, very properly, been a great deal of interest in the more important hereditary characters, but perhaps too little in those inconsequential ones which are nevertheless equally good material from the genetic standpoint.

As I have accumulated these family studies over a period of years, I am deeply impressed by the evidences of inheritance for a multiplicity of characters so minute that they may not be noticed unless attention is directed to them. Accurate information is perhaps more easily obtained for these inconsequential traits, since there is little reluctance on the part of the persons and families affected to placing their traits on record.

The first chart will serve to refresh your memories of the use of the conventional symbols. The squares represent the more angular male members of the family, while the circles indicate the undoubtedly more curvaceous females. The horizontal lines which connect certain squares to the appropriate circles are graphic representations of the bonds of matrimony—things that you hear a lot about, but rarely see.

Vertical lines connect these in turn with the child or with the fraternity of children derived from each pair of parents. Other relationships may be readily seen. We are without doubt fortunate to be working with families that are chiefly rural and of the population trend characteristic of the southeastern states, since here we have, in the native born white population, larger average family size than we would expect elsewhere. I think that you may well be impressed by the fertility of these West Virginia families.

This chart shows the inheritance of partial or pattern baldness; a character that is rather rare in women, but quite common in men. About 25 years ago Dorothy Osborne showed quite conclusively that the presence or absence of hair upon the top of the head is inherited in the same fashion that is known for the inheritance of horns and hornlessness in certain breeds of sheep. The factor for pattern baldness

behaves as a simple dominant in men, and as a simple recessive in women. It is therefore sex-influenced, not sex-linked. Women with this character usually show only a small crown spot, or a temporal spot that is bald. In most cases these spots are efficiently concealed. The character is transmitted from a father to half of his sons, or equally well from a non-bald mother who carries the factor to half of her sons. It sometimes thus happens that the factor is transmitted through the maternal line for several generations, and that then the character appears in one of the male descendants who is now unable to discover it in any other members of the family. In different families there are different patterns, and two of the most common types are diagrammed on our next chart. Here also some cases of the appearance of baldness in women are indicated. Such women must have bald fathers, and mothers who carry the factor, or who are themselves bald also. In Pittsburgh, judging by the advertisements seen in the newspapers, there is a very thriving industry devoted to the treatment and cure of baldness. However, so far as I know, none of these institutions has thus far been able to find a method for the inactivation of the gene for pattern baldness. The claim that has been made, that eighty-five percent of all cases will respond to treatment, seems either to be unduly optimistic, or else to include, no doubt as a printer's error, the omission of the word "not" before respond.

Another rather common trait is early or premature graying of the hair; either scattered gray hairs increasing in numbers from about twenty years of age upwards, or complete whitening of the hair at around thirty years of age. In three of the seven families in which this trait is recorded, it is shown in men only, in so far as our records

go. By totaling all seven families we can count ninety male and forty-nine female births, and find about two-thirds of the males and one-half of the females affected. Because of the small numbers involved these proportions may be of no significance.

On the average one pair of twins is born out of about 75 or 85 births; but this average is obtained by combining the records from twin-bearing families and non-twin-bearing families. In six twin-bearing families, including four to be shown on our charts, there are 38 twin births and 148 single births. The 76 twins comprise more than one-third of the total 224 offspring. In thirteen other families there were two pairs, or four twins, among 402 offspring, fewer than one hundred. It is probably not chance alone that some families are presented with twins once in 200 births; while others are doubly blessed every fourth or fifth time that a blessed event occurs. These facts should be of particular interest to the younger, unmarried men, for most of this twinning seems to descend. Though expressed in the females, the hereditary factors for twinning may be transmitted through the male line, and in some cases a direct effect of the father on the production of twins is strongly indicated. Thus in one family shown there are six pairs of twins in 28 births, and five of these six pairs have the same last name. An alternative explanation would be that each of the four women who married into this family were themselves from such high twin-producing strains that they were each able to bear one set of twins in from two to four births. Only about one family in forty seems to carry this capacity, so that the chance that the second explanation is valid is a very small one.

The inheritance of allergy seems to be a subject of controversy. It is possi-

ble that all of us might be able to develop one or another type of allergy under the appropriate stimulus. On the other hand we find severe allergic symptoms distributed among the members of certain families in such a way that the condition seems clearly to be inherited. A number of investigators have concluded that a basic factor for allergy which is inherited as a simple dominant, is that the expression of the allergy may further depend upon environmental conditions or upon modifying genetic factors. Two family charts here shown certainly suggest this type of inheritance, with the dominant allergic condition expressed as asthma, hay fever, migraine, hives, eczema, urticaria, and sensitivity to specific proteins. In one of these charts the propositus, a girl who is the daughter of a well-known physician, shows five allergic cases in her parents, grandparents, and one great-grand parent. She has suffered from asthma, hay fever, hives, and eczema. Neither of her two sisters has shown any traces of allergies.

There are certain inherited traits that occur in severe form in some families, and in a mild form in others. In order to avoid the "chamber of horrors" aspect that discussions of human heredity frequently assume, we have prepared charts showing the milder aspect of a well-known trait, hare-lip. In the more severe cases this defect,—a failure of the upper lip to close along the median line,—is associated with cleft palate and other abnormalities. In the rather extensive family described the inheritance is apparently that of a simple dominant factor, and the abnormality is a rather minor one, not known to extend to other structures than the lip itself. Two pedigrees are available to show the inheritance of skin blisters. This dominant

type is much less severe than the recessive form that has been reported in other families. The affected persons, particularly at ages of from about 10 to 40 years, produce blisters on the hands, feet, and perhaps on other areas of the skin that are subjected to friction. Especially in warm weather such activities as walking, working with the hands, and so forth must be curtailed. Another character that interferes with walking is the "foot-bump" that has appeared more or less regularly in two families included in our present list. It is difficult for these people to find comfortable shoes, and walking tires them, so that they tend to sedentary occupations. There are many minor hereditary characters of the hands and feet, fingers and toes besides such extremes as brachydactyly, polydactyly, and syndactyly (which are usually described in text books). A rather common variation is the long second toe, or perhaps it is a short great toe. Equality in the length of the first two toes is perhaps less usual. Partial or complete webbing of some or of all of toes occurs in many West Virginia families, and some cases suggest sex-limitation or sex-influencing.

The presumptive inheritance of what, for want of a better name, has been called a "hand disease" is shown in another chart. The family is a very well known one in our state, and family records seems to be rather complete and precise. The hand disease occurs in two forms, severe and mild. There is periodic or irregular cracking and scaling of the skin. In the severe type the condition is very troublesome, and frequently involves subsequent infections. One type does not pass over into the other; the mild form never reaches the severe condition, and although the severe type may "clear up" for extended periods, when it again reap-

pears it is always the same type. Diagnosis and treatment seems to have been a difficult matter for the various physicians who have been consulted by the different individuals.

Perhaps most people have a number of small skin blemishes,—birthmarks, moles, cysts and the like,—at various places. Not infrequently a general correspondence is found in the type, size, and position of a certain mark upon the skin of both a parent and child. Such cases seem to be coincidences, for certainly there are many other marks which show no such similarities. However, when one of these marks appears in an exposed and prominent area, such as on the face, it can be readily traced and its presence or absence noted for the various members of a family. Pictures and photographs may even be of some service in supplementing the observations that can be made directly. Thus in two family pedigrees we have a mole in a limited area on the face, of about the same type and size, first in four cases and in the second family in six cases within three generations, and four generations respectively. These coincidences seem here to be accumulating. What are we to say then concerning the following cases in some other families? First is the family which shows 19 cases of a mole on the right cheek between the corner of the mouth and the ear. Here is included one group of 13 brothers and sisters, of whom five had the mole that also appeared in their father. Four of the five married, and among their children in turn nine have the mark, seven do not have it, and three are not recorded. In a second family there is a mole, of somewhat different type, on the left side of the face, below the eye and close to the nose. Three sis-

ters and one of their brothers had this blemish, while the other brother (who was not married) did not have it. In the next generation ten are known to have the mark, and three are known to lack it, while one is not recorded. Among the grand-children, offspring of nine of the ten affected in the second generation, 16 show the mole and 21 do not show it. These moles show ample evidence for inheritance on the basis of a single dominant factor.

A third family reports the indicated mark as a cyst, an unpigmented mass of rather small size, on the right side of the nose. It is shown as affecting 13 persons in five generations. There are some unusual and interesting points in this case. Twelve of the 13 who are marked are females, only one male. It seems to be transmitted by mothers who show the trait, and by fathers who do not show it. The one male who is shown with the trait does not fit the case, but if it were not for this exception we would have just the reverse of the type of inheritance that we have seen in the pedigrees of pattern-baldness; that is to say, a sex-influenced factor that is here dominant in the females and recessive in the males. Inheritance of this type has recently been reported for an inherited abnormality of the skin and body-hair follicles.

It is hoped that this discussion, based on these cases, may have suggested that there are perhaps many inherited characters in humans besides those usually treated in text-books on genetics and general biology. Due to the sources of our material, we cannot guarantee that the facts and conclusions are all correct, but we have attempted to choose those cases which we believe to be reliable.

Methods of Plant Improvement

SAMI RAFEI

Long before anyone thought of making a philosophical study of plant improvement, the hybridization of flowers and the preservation of choice strains of favorite varieties were common among gardeners. The oldest records of intentional preservation of plants are found in ancient Chinese encyclopedias. The best plants and fruit trees were used for propagation, and an imperial edict recommended the choice of large seeds. Nearly as ancient are the fig drawings on the great pyramid of Egypt. According to Fruwirth, hybridization was practiced in ancient times in China with various flowers, in Italy during the Roman Empire with roses, and in the seventeenth century in Holland with tulips and primulas. From Darwin's account it seems that the earliest methodical work on the production of new varieties, of which there are authentic records, was done by the Dutch flower fanciers.

The great world movement of the last part of the eighteenth century and of the nineteenth century following the improvement of transportation facilities, the migration of peoples, industrial development, and the growth of international trade, together with the improvement of farm machinery, resulted in the extension of agricultural industries and gave a great impetus to plant improvement. This activity was manifested first in Europe and later particularly in the U. S. Department of Agriculture and in the

state experiment stations in America. Efforts at improvement were concentrated mainly on the crop plants producing the raw materials of importance in the world's markets.

The improvement of plants is the ultimate goal of many persons interested in the propagation of plants. The mere multiplication and continuation of the same characteristics would not cause much advancement for horticulture or for farm crops.

The breeder should always know exactly what he is aiming at in the way of plant improvement. Vague expectations may sometimes be satisfied by a haphazard cross, but only definite aims will ensure steady progress.

The breeder who knows something of the laws and mechanism of heredity; who knows his plants and keeps a careful record of their behavior in inheritance; who has an observant eye and a mind quick to interpret his results—that breeder will soon acquire a large capital of knowledge which, invested in wisely chosen programmes of work, is bound to yield a good return.

METHODS OF IMPROVEMENT

A plant can be improved in two ways:

1. By a change in the conditions under which the plant grows, that is its environment or,
2. By a change in its hereditary constitution.

FLUCTUATIONS

The first kind of improvement is due to a change outside the plant, e.g. transplanting from a poor to a rich soil and other such changes in cultivation or climate. Improvements such as these are of a temporary nature only, and are not inherited. Thus seeds saved from a well-fed plant will, other things being equal, give progeny no better and no worse than the seeds saved from a starved plant, and vice versa. The big difference between a starved and a well-fed plant is a fluctuation caused by a difference of environment.

This does not mean that it is of no consequence whether the grower saves his seed from good or bad plants of the same strain. A plant which starts life as a starved and shrivelled seed is handicapped from the beginning, even though in the end it is no different from the plant which came from a good plump seed, under favorable environmental conditions. Rather does it mean that the breeder will not necessarily improve a strain by selecting the largest plants. A plant of a potentially large strain may actually be smaller, through unfavorable environmental conditions, than a plant inherently smaller but enjoying exceptionally good conditions. However drastic the effect of the environment upon the characters of the plant, the genes are not altered. In other words, acquired characters are not inherited.

It will be clear from the above remarks that the breeder is concerned with heritable variations only. Indeed, fluctuations will misdirect him, and obscure his results. In breeding work, therefore, it is important that the plants should be grown under favorable and uniform conditions of soil, moisture, light, and temperature; since only then can we be fairly certain that any differences observed are variations

that will be inherited. At the same time the cultural conditions should be reasonably good; since it is then easier to recognize desirable variations, inferior forms in particular often doing best under poor cultural conditions and in bad growing seasons. In certain instances, however, indifferent conditions might reveal qualities masked by good conditions.

Therefore in choosing his planting site, the grower must always have in mind that the functions governing the growth and successful reproduction of plants are limited by definite ranges of intensity of particular climatic, edaphic, and biotic factors. These ranges represent the tolerance of the function for the particular factor, and they must be provided to insure good results.

VARIATIONS

The second kind of improvement is due to change inside the plant, and though differences in the environment may somewhat alter the character concerned, the improvement is in essence a permanent one, and is inherited. Changes of this kind are known as variations. The variations by which new varieties and species of plants may be improved are as follows:

1. From mutations within a single gene.
2. By simple auto-polyploidy, such as results from somatic duplication or from the function of unreduced germ cells.
3. By selection from products of inter-specific hybridization unaccompanied by chromosome duplication or nuclear aberration.

1. Gene Mutations

The part which gene mutations have played in the origin of new and improved plants is well illustrated in

sweet pea, edible pea, Chinese primrose, raspberry, and other horticultural plants. Variations in color, form, size, season, form of plant, or leaf may appear. The character may be an intensification of one already present in the parent or it may be an entirely new one that has been concealed somewhere in the parent tissue. The various color strains, the weeping and dwarf forms of ornamentals, the early-blooming or late-ripening strains of certain fruit varieties are other examples.

Gene mutations result spontaneously from inherent genetic changes. They are not due to hybridization, nor, as is sometimes supposed, to the direct effects of cultivation.

It is not clear what is the cause or causes of change although irradiation, for example, has been used to bring such changes about. A gene which controls, let us say, the resistance of the plant to cold suddenly mutates so that the plant is slightly resistant to cold. This mutation may be beneficial or harmful according to the environment of the plant, but if it assists in the plant's struggle for existence, the mutant gene will be handed on to successive generations; since the plants carrying the gene have a better chance of survival than those without it. Most gene mutations are recessive mutations, and only occasionally are dominant mutations found.

Gene mutation is a very important source of plant improvement.

2. Simple auto-polyploids

The second way in which new forms of cultivated plants have risen is by simple auto-polyploidy. In this case the chromosome complement is duplicated, either somatically or as a result of unreduced germ-cells taking part fertilization, without hybridization being involved. The tetraploid forms of

raspberries, which include such varieties as Belle de Fontenay, Merveille Rouge, and Everbearing are auto-polyploids. They appear to have arisen from diploids in the last hundred years. Plants of the tetraploid race of *Primula sinensis* are giant auto-polyploids. They arose from the diploids $2n=24$, spontaneously at the beginning of the present century.

In pears the recent new giant tetraploid forms $2n=68$, of the varieties Fertility and Bartlett, arose from their respectively diploid varieties. They appear to be the first tetraploid forms of the European pears *P. communis*.

In grapes the varieties Muscat and Sultanina have 38 chromosomes, whilst their respective giant forms *Muscat gigas* and *Sultanina gigas* have 76 ($2n$). The above are examples of auto-polyploids which have arisen from a complete duplication of the chromosome complement.

Sometimes in *Primula*, they have originated through the sexual process, and sometimes, as in pears, vegetatively from somatic duplication. Many new forms have also arisen from unilateral duplication. For example, the triploid varieties of apples and pears apparently arose from the fusion of an unreduced germ-cell, $2n=17$. Some of the finest varieties of tulip and hyacinth are triploids of a similar origin. In the tulip they include Keizerskroon and Pink Beauty, which are early varieties with exceptionally large flowers, and Massenet, a tall pink Darwin.

Triploids are common among plants which are vegetatively reproduced, whether artificially by budding, grafting, cuttings, etc., or naturally by means of bulbs, corms, tuber, and other methods, e.g. several of the highly decorative varieties of Japanese cherry are triploids.

Some of the most important varieties of flowers and fruits in the world are triploids. In apples the triploids include the outstanding varieties, Bramley's Seedling, Belle de Boshoop, and Baldwin.

In addition to the auto-triploids which originate in the way described above, triploids also commonly arise from the intercrossing of diploid and tetraploid forms or species.

3. *Inter-specific Hybrids*

The third method of improvement is by inter-specific hybridization between diploid species or between polyploid species, without chromosome duplication or other major cytological aberration being involved.

Intraspecific or intervarietal hybridization is also an important source for new improved varieties and strains.

As shown by Bunyard (1917) three species of *Ribes* have entered into the constitution of the garden red currant, namely *Ribes vulgare*, *R. rubrum* and *R. petraeum*. Some of the cultivated varieties strongly favor one or another of these three species; others combine the characters of two of them. The three species, and all the varieties examined, are alike in chromosome number.

The garden strawberries are an example of the origin of new race of plants from hybridization between polyploid species. The introduction into Europe, and the bringing together, of the two octoploid species, *Fragaria virginiana* from eastern North America and *F. chiloensis* from South America, provided the first opportunity of raising the large-sized fruits characteristic of our modern race. The first varieties of this type, combining the large size of *F. chiloensis* with the aromatic qualities of *F. virginiana*, appeared in Europe towards the end of the eighteenth century.

Among the many other genera in which species hybridization without chromosome doubling has given rise to new races of cultivated plants may be mentioned *Rubus*, *Streptocarpus*, *Rhododendron*, *Vitis* and *Iris*.

4. *Allo-polyploids*

The fourth and most important way in which new forms have arisen is by inter-specific hybridization in which unreduced germ-cells have taken part, or where somatic duplication of the chromosome complement has subsequently occurred. As before, there is sometimes complete duplication of the complement and sometimes unilateral duplication, i.e. non-reduction of the germ cell of one parent alone. Details are given below of several important races and species of cultivated plants which have originated in this way.

a. *Delphinium Ruysii* arose from hybridization between *D. nudicaule* ($2n=16$) and *D. elatum* ($2n=32$). *D. Ruysii* also has thirty-two chromosomes and arose from unilateral duplication on the female side.

Another new *Delphinium* hybrid (not yet named) arose as an amphidiploid between *D. cashmerianum* and *D. cardinale*. Both the parents have $2n=16$ each, while the hybrid has $2n=32$.

b. *Prunus domestica* has probably arisen on many different occasions in prehistoric and historic times from hybridization between diploid and tetraploid species, followed by chromosome duplication to give the fertile hexaploid *P. domestica*.

Indeed the results of breeding experiments with species and varieties of *Prunus* have led to the conclusion that the diploid species *P. divaricata* and the tetraploid species *P. spinosa* are involved in the origin of *P. domestica*. This is supported by Lawrence (1930) in England and by Rybin (1936) in Russia.

Precise knowledge of the method of origin of particular polyploids is often lacking, but it is clear that the functioning of unreduced germ-cells is a frequent method by which new polyploid forms, varieties, and species arise. But the possibility of cells of apomictic origin being fertilized and giving rise to polyploid forms must also be considered. For example, in the genus *Rubus*, opogamy, resulting in two maternal offspring, appears to be frequent. Again, in this genus many cases of new polyploid forms alleged to have arisen from unreduced germ-cells have been reduced. Since opogamy occurs, however, the question arises as to whether new polyploids always form unreduced germ-cells, or whether they may not also arise from the union of male germ-cells with $2n$ maternal apomictic cells.

Somatic doubling of the chromosomes also occurs and the origin of the tetraploid *Primula kewensis* ($2n=36$) provides a good example. As reported by Digby (1912) and later by Newton and Pellew (1929), the sterile diploid hybrid between *P. floribunda* ($2n=18$) and *P. verticillata* ($2n=18$) produced a branch with fertile flowers. Tetraploid offspring ($2n=36$) which bred approximately true were obtained from this branch, which had double the chromosome number of the rest of the plant tissue.

Some examples of somatic duplication were found by Blakeslee and Belling (1924). On several occasions, mainly after low temperature treatment, they found tetraploid ($2n=48$) branches on normal diploid plants of *Datura stramonium*. These branches gave tetraploid offspring. Branches were also found with an aneuploid chromosome constitution i.e. $2n\pm 1$.

Somatic duplication has also been

reported in *Nicotiana* (Clausen and Goodspeed, 1925).

During recent years attempts have been made to accelerate mutations and to induce polyploidy by artificial means. Chemicals, extremes of temperature, X-rays and other radiations have all been used to induce and to accelerate the rate of mutation. Baur (1931), for example, found in *Antirrhinum* that as many mutations occurred in the year following X-ray treatment as had occurred in the whole of the previous twelve years. Polyploids have also been deliberately produced by decapitation, wounding, etc. (Winkler, Yorgensen and Crane).

Recently colchicine has been successfully used to induce chromosome duplication, (Blakeslee and Avery, 1937). By treatment with the same chemical Nebel and Ruttle (1938) have obtained tetraploid forms of marigold, tomato, *Dianthus* and other plants.

The possibilities of obtaining fertile progeny from cross-breeding in polyploid genera are often limited by the numerical relations of their chromosome complements. For example, the offspring from a diploid crossed with a tetraploid will be triploid, and those from a tetraploid crossed with a hexaploid will be pentaploid and usually highly sterile, but exceptional seedlings may occasionally arise from such crosses.

In such cases, where the sexual process is essential for the purpose of obtaining either seed or fruit, fertility is of the first importance. But in ornamental plants which can be readily reproduced asexually, sterility may not necessarily concern the practical grower. Indeed, in some respects it may be rather an asset than otherwise. For example, many of the Japanese cherries which are grown for a display of flowers are triploid and highly sterile. They

do not expend energy and exhaust themselves in the production of heavy crops of fruit, and as a result they invariably flower abundantly year after year. The same applies to many other vegetatively propagated ornamental trees, shrubs, and herbaceous plants.

Although new forms and species which arise from inter-specific hybridization reproduce themselves as new and distinctive types, great variation may occur subsequently as a result of recombination and interaction of the many different genes brought together. These are the kinds of complications which have frequently caused practical breeders of plants to doubt the truth of the Mendelian theory of heredity. Since the complexity of the nucleus and the manner of chromosome pairing is reflected in the range and nature of the variation and in the mode of inheritance of characters, the practical breeder must expect to find different degrees of complexity in the hereditary behaviour of plants.

SOME RESULTS OF PLANT IMPROVEMENT

During the past two or three decades considerable progress has been made in the breeding of agricultural crops for specific purposes. A notable achievement was the breeding of bread wheat for resistance to rust and smut. At the present time much breeding work is being done with horticultural crops in an attempt to combine such characters as early maturity, resistance to cold, drought, disease, etc. with size, quality, and other desirable characters.

The exhaustive plant breeding experiments being carried out by Vavilov and his colleagues in the U. S. S. R. have recently been reported upon by the Imperial Bureaux of Plant Genetics. Realizing the limitations and inadequacy of the material at their disposal, the Soviet breeders have sent expeditions to many parts of the world

and have made an unrivalled collection of plant breeding material. Among the numerous plants they have under investigation are cabbages, peas, beans, potatoes, artichokes, tomatoes, carrots, beets, onions, melons, strawberries, raspberries, gooseberries, cherries, grapes, etc. The aims of these exhaustive experiments include breeding for the improvement of quality, early and late maturity, resistance to cold, drought, disease, and many other purposes. The economic aspects of sterility and incompatibility, the induction of mutations and polyploidy and the practical possibilities of certain forms of plant chimaeras are also being investigated. It is clear, however, that there still remain many possibilities in the field of plant breeding.

In America a profitable investigation has been the breeding of tobacco plants with a very high nicotine content, for use as a source of valuable insecticide. The hybrid vigor phenomenon is highly utilized in growing of corn and many other crops.

Many state stations have done and are doing notable work in the field of breeding, and the list of new varieties is growing to respectable length in several crops as tomato, potato, cucurbits, berries, legumes, cruciferous fruits and flowers, etc. Federal workers have also been very active.

The commercial catalogues of the horticulturists contain yearly a great number of novelties which have resulted from breeding work and plant improvement. Exhaustive work has been carried by Baur at the plant-breeding station at Müncheberg and the Institute of Phylloxera Research at Naumberg in hope of getting varieties of grapes resistant to *Phylloxera* and *Plasmopara*. The object was to breed grapes which combine high quality with resistance to the two pests. In

North America varieties of the vine *Vitis rupestris* are resistant both to *Phylloxera* and *Plasmopara*, but the berries are poor in quality. The *rupestris* varieties can, however, be crossed with the high quality varieties of the susceptible European grape vine *Vitis vinifera*. Baur states that the hybrids between these species are perfectly fertile, and that among the numerous types which segregate in the subsequent generations it is expected that some few types will occur representing the ideal combination of absolute resistance to *Phylloxera* and *Plasmopara* on the one hand and high quality of *vinifera* berries on the other.

Baur stated that 5-10 million seeds were used in such a search. All seedlings are artificially injected and tested for *Plasmopara* and only the few which prove absolutely resistant are retained. Of course such work is very expensive, but Baur calculated that in about ten years the desired types would have been found and the enormous annual expenditure on spraying, etc. rendered unnecessary.

CONCLUSION

From the examples and methods given above it is clear that mutation, polyploidy, and hybridization are fundamental in plant improvement. They are the principal causes of variation, the process by which evolution continues; so real progress in plant improvement depends ultimately on the

acquisition of knowledge which will lead to the control of these processes.

There are several points the breeder should never forget. He should be observant. The slightest indication of a new variation may be the starting point of a distinct success. As a general rule he should cross only the best kinds together. Crossing inferior forms, or a good one with a poor one, in the hope of something good turning up is unscientific. The breeder should always aim for purity of strain. A variety which does not breed true is a source of annoyance to the grower and a bad advertisement for the breeder.

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*Spermatogenesis in Testis of Salamander (*Amblystoma tigris*)*

LORIN MICKEY

The following study was made from slides of longitudinal sections of the nearly ripe testis of a mature animal and is subject to the limitations imposed by such a method of study.

To explain the appearance of the slides, a description of the gross morphology of the organ is necessary. The ripe paired testes of the salamander consist of two or three lobes connected by strands of genital tissue. In a typical lobe three zones are present, a zone of spermatogonia, one of spermatocytes, and a region of developing spermatids and spermatozoa. Each zone represents a generation of sperm. In the mating season the mature sperm leave the testis, and a strand of stroma lined with spermatogonia remains. Thus it will be seen that there is a continuous spermatogenic wave moving slowly forward (1).

Considering a section as a whole, three areas of approximately equal extent may be discerned. Anteriorly there is an area of large uniform round cells with large granular nuclei, the spermatocytes. Posterior to this is an area of cells similar to those just described but smaller, the spermatogonia. The most posterior region is composed of groups of spermatids in various stages of development, and mature spermatozoa. On the posterior border of this area a group of strands of stroma may be observed representing a zone from which mature sperm have migrated. The germinal cells are sur-

rounded by a germinal epithelium one layer of cells thick. Connective tissue partitions divide the germinal tissue into capsules containing from twenty to thirty cells. All of the cells in a given capsule are in the same stage of development, and in capsules containing dividing cells, all of them are in the same phase of mitosis.

It has definitely been decided that the spermatogonia originate from cells migrating from the epithelium or stroma surrounding the germ plasm (2). In the connective tissue strands permeating the germinal elements, cells were seen which correspond in general appearance to the spermatogonia. There was no evidence of the processes of division and growth through which spermatogonia progress to become spermatocytes.

In the spermatocytes studied, mitoses were numerous in capsules on the periphery and at the junction of the anterior and median zones. Two kinds of mitoses were observed. In one kind, from a polar view, fourteen to eighteen U-shaped chromosomes could be counted migrating to the centrosomes. In the other kind, only six or eight could be counted. (The diploid number of chromosomes is twenty-four and the haploid number is twelve). Therefore these two mitoses are the equational and reductional maturation divisions of the spermatocytes. Both were observed in the same section.

In the posterior zone, spermatids were present in varying stages of development. The most immature ones differed from spermatocytes only in possessing elongate nuclei. The continuous process of growth was represented by capsules of cells with variously elongating nuclei. Finally, groups of sperm were distinguishable consisting of a small spherical acrosome, a very thin, long, filiform head piece, and an almost invisible end piece. Attached to each capsule in this zone were one or two large, pale sustentacular cells. As the nuclei and cell walls had taken a very dark stain, the centrosome and idiosome could not be seen. Therefore it was impossible to observe the role

of these elements in the process of spermatid transformation. Such a study would necessitate different staining methods.

In about half of the capsules of spermatogonia and in some of those containing spermatocytes, red-staining bodies were present in the cytoplasm of the cells. They appeared to form a cap-like structure over the nucleus. The identity or function of these elements could not be determined.

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Histological Appearance of Notochordal Tissue in *Amphioxus*, Chick and Pig

WILLIAM T. DRISCOLL

Throughout the animal kingdom, with the exception of perhaps some of the lowest forms of animal life, there is found some attempt to produce rigidity of structure. The *Invertebrata* exhibit many forms of stiffening devices, but we have attributed solely to the *Chordata* the ability to develop the special rod of cells known as the notochord. In the unsegmented Annelid, *Sipunculid*, however, there are to be found cells which appear identical with the vacuolated cells characteristic of the notochord in the *Chordata*. These cells are to be found in the so-called lower lip of the animal and seem to serve as a stiffening device just as the true notochordal cells serve in higher forms.

According to most writers the notochord arises from the undifferentiated tissue at the lip of the blastopore along with the development of mesoderm. Modifications during development do arise in the various species, but the ultimate origin seems to be essentially the same. Typically the tissue of the notochord appears as large vacuolated cells containing a fluid or gelatinous substance called by some, cell sap (2). The cytoplasm is stretched so as to appear as a very thin layer surrounding the vacuole, looking almost like a cell membrane. At one point the cytoplasm is somewhat thickened to contain the nucleus. The tissue appears as a mass of soap bubbles when viewed

under the microscope. The fluid content and the turgidity of the cell is thought to give some support to the embryo. Some writers say that the support is produced by the outer cytoplasm which secretes around the cell a relatively dense, stiff wall which becomes the cell organ of rigidity (2). Thus the cell in accompaniment with the cells around it gives the characteristic firmness to the notochord.

In amphioxus, where the notochord is the only axial support ever possessed by the animal, the tissue appears in the typical form. Large cells presenting characteristically the fluid-filled vacuoles and scanty cytoplasm. The nucleus is crowded to the periphery of the cell. The tissue, however, does not look like a mass of soap bubbles with clear-cut open vacuoles and thin dividing membranes, but rather, it presents a striated appearance. This is probably caused by the failure of the gelatinous fluid present to section properly. The cell divisions, nevertheless, are present though they are indistinct.

The chick again presents the characteristic vacuolated cell, but here there seems to be an increased amount of intercellular substance present, especially in the seventy-two hour chick. In the ninety-two hour chick, the vacuoles seem to enlarge, and a decrease in the amount of intercellular substance is noted. The cells of

Sipunculid resemble the chick cells more closely than they do the pig or *Amphioxus* cells in that the *Sipunculid* cells are also suspended in a matrix of intercellular substance.

The notochord in the ten mm. pig is very inconspicuous and rather difficult to see. The vacuolated cells are present but are much smaller and with less dense intercellular material than in the chick.

The notochordal sheath is a double sheath of connective tissue which, in *Amphioxus*, surrounds the neural tube also. This sheath in the chick and the pig is less conspicuous and there seems to be no direct connection through it between the notochord and the neural tube.

The notochord is later surrounded by mesodermal cells which produce or develop into the centra of the vertebrae and the intervertebral ligaments. In

the fish the notochord forms an alternately expanded and contracted rod of gelatinous pulp in the vertebral column. In man, the vestige of the notochord is the *nuclei pulposi*, a tissue resembling cartilage, having a vacuolated syncytium in a gelatinous matrix, bounded at the periphery by a structureless membrane.

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Histological Differentiation Between Male and Female Gonads of Amphioxus

HELEN DEXTER

The genital organs of *Amphioxus* begin to develop before the end of the larval period. They appear first as buds, or small groups of cells, arranged metamerically along the lateral body wall, in all the somites from nine to thirty-five or thirty-six. They appear on the floor of the myocoel where the skeletogenous region merges into the cutis.

This is the region of the nephrostome in Craniates, and so the gonadal cavities in *Amphioxus* have been compared to the nephrostome of higher forms, though the origin and position here is necessarily more primitive.

A brief summary of the development of the gonads will clarify markedly the significance of the structure of the adult organ.

Before metamorphosis, the rudiments of the genital organs make their appearance as small buds of cells which proliferate from the antero-ventral angles of the myotomes near the atrial surface. They arise along the posterior face of the dissepiment separating the surrounding myocoel from the one next anterior. The bud pushes forward, covered by that portion of the myocoel anterior to the one in which the gonadal swelling first appeared.

The covering becomes sac-like but retains a connection by a short stalk

to the septum. In this region develop two specialized areas, the cicatrices.

Therefore, it is evident that each egg is not surrounded by its individual follicle, but is attached to the wall of the enclosing sac which thus serves as a general follicle for all the ova which develop within it.

As development ensues, the ventral-most portions of each myocoel containing the gonad becomes separated by the growth of a septum from the more dorsal portion to form the gonocoel.

The solid gonadial rudiment soon develops a cavity and simultaneously it pushed anteriorly in such a way that the visceral wall of the gonocoel is formed by the dissepiment, and the parietal wall is formed by a lateral down-growth of the myotomal wall.

With development, the definitive germ cells are crowded to the lateral-most border of the gonadial cavity, where they become surrounded by follicular epithelium, which is also formed from the cells of the original mass.

As the gonadial cells enlarge and multiply, they force their mass in upon the cavities surrounding the genital organ, nearly obscuring them, particularly those lying toward the myotomal surface.

When the germ cells are fully developed, the gonadial envelopes, infiltrated with muscle fibers, contract, seemingly aiding in this manner in the rupturing of the visceral lining of the gonocoel.

This contracting action forces the germ cells into the surrounding cavity where they remain until ready for extrusion. This process is brought about by strong contractions of the body wall which serve to force the ova through the outer wall of the gonadial membrane in the region of the cicatrices.

From there, they are forced into the atrial cavity where the respiratory current carries the ova out into the surrounding water.

The female gonad, or ovary, is made up of large, irregularly but geometrically-shaped ova, in close contact with each other and lying all within the single follicular sac of simple squamous epithelium. In the slides which I studied, the follicular epithelium had been forced aside by the enlargement of the developing germinal cells, to lie in small areas lining the cavity of the gonad. The germinal cells, by their

nearly uniform size, and the nuclear state were apparently primary oocytes in early stages of multiplication. The cells are granular in appearance, the cytoplasm being very heavily granulated except for a yolkless area just below the surface, and a yolk-free space between the nucleus and the cell limit.

The nucleus is large and lies nearer one pole than the other. Upon the position of the nucleus and the absence of yolk particles between the nucleus and its nearer pole, is based the classification of the egg—telolecithal. The position of the nucleus has a definite influence upon the orientation of the ovum, for the pole at which it is located becomes the animal pole.

The male gonad of the testis is strikingly different in appearance from the ovary. In contrast, the cells are very small, so that very little cell detail can be discerned even under the oil immersion lens. The minute primordial sperm cells are extremely numerous, and are seemingly arranged in a striated, irregular pattern, the cells being imbedded upon a background of fibrous, indefinite tissue.



Black Widow

HARLEY BROWN

Who has not heard of the dread Black Widow? Many have chilled at the sound of her name. Her reputation has descended through the ages. Her cousin, the Malmignatte of Italy, has demanded European respect for centuries, but no other spider is so deadly as America's Black Widow, though she be called Shoebutton spider, Hour-glass spider, or Messenger of Death. It is this dusky demon, *Latrodectus mactans* to men of science, which I find so fascinating as to merit many hours of study. Actually, she is not so wicked as my introduction might lead one to believe.

This glossy creature with such a terrible reputation is, in reality, inclined to be timid and retiring. Nocturnal by nature, she rarely is to be seen abroad by day. She chooses a secluded spot, sheltered and inconspicuous, to make her home. Then she sticks by it. But what a home! Indeed, it is a disgrace to the spider kingdom . . . messy and haphazard. But it indicates to us that the Black Widow belongs to the same family as does the common house spider, *Theridion tepidariorum*. In fact, *Latrodectus* is the largest of the family *Theridiidae*. Returning to the subject of her home site, I may state that she has been found in old clothes, autos, furniture, attics, basements, garages, barns, trash heaps, factories, bushes, stumps, privies . . . indeed, almost anyplace imaginable. She is quite apt to be found under wood or stones. Since she prefers privacy, we are not likely to see her.

Consequently, many of us think the Black Widow rare. This is certainly not the case, as shown by the fact that Black Widows have been officially reported from every state in the U. S., as well as in several provinces of Canada. In at least thirty-two counties of Ohio they have been observed. And they are not of recent innovation, for I have found references as far back as 1812, from Miami county, Ohio, discussing a remedy (a paste of indigo and vinegar) for the bite of the black spider with the red hour-glass beneath its abdomen. Even farther back and more striking are the tales of certain Pacific coast Indians, who used to crush Black Widows, using the paste thus obtained for poisoning their arrows. A superficial wound made by such an arrow was said to kill a deer within five minutes.

It was not until about ten years ago that America became conscious of her Black Widow population. Quite a scare arose, newspapers and magazines proclaiming the fact that these spiders were on the increase. In southern California the San Diegan alligator lizard was introduced to control the Black Widow. Much discussion and study arose. It was discovered in Louisiana that the common blue mud-dauber, *Chalybion syaneum* (Klug), was as effective a control agent as could be desired. As a sample, fifteen nests of this mud-dauber were examined and found to contain 285 Black Widow remains—an average of about 19 per nest. This surprising number of spiders

served as food for the young wasps. Then, too, there is a parasitic fly, *Gaurax araneae*, which plays its part in making the existence of young Black Widows less likely. It deposits its eggs upon the egg-sac of the spider. Larvae hatch almost immediately, bore inward, and dine upon the developing spiders. Soon they pupate, later emerging to repeat the cycle. The life of *Latrodectus* is no bed of roses.

Most of us know that a Black Widow is shiny black, long legged, with a shcebutton-like abdomen, has a red hour-glass on the under side of her abdomen, with perhaps other red markings about her spinnerets. We know, too, that she usually devours her husband after he has served his purpose. I might, however, mention the fact that immature females have markings quite similar to those of the male. The legs are more or less banded with orange, yellow or white, while the abdomen bears conspicuous longitudinal stripes of red, orange, yellow, or white. Nevertheless, after the second moult, the red hour-glass is almost always perceptible beneath the abdomen. Before the second moult, the young spiders are reddish, except for a spot on the ventral side of the abdomen, which is then black. These young spiders look remarkably like the common house spider.

The bite of the *Latrodectus* is a serious matter, as her poison is said to be approximately twenty times as potent as that of a rattlesnake, and her poison glands are so enlarged as to occupy much of her cephalothorax, as well as the interior of her chelicerae, which is the normal position for a spider's poison glands. She is not vicious, but if provoked will generally protect herself and her young. Her poison ducts seem to be voluntarily

controlled. That is, upon biting, she can either emit or retain her poison, as she sees fit. If an average person should be bitten, receiving the usual amount of poison, he would soon feel sharp pains arising in his stomach, within fifteen minutes he would probably be completely collapsed, unable to move a muscle. If fortunate enough to live, he would suffer almost unbearable pains in his chest, thighs, legs, and brain, accompanied by violent nausea for several days. But thereafter, so far as we know, he would be immune to Black Widow venom, and his blood would be valuable for transfusion to future victims of arachnidism. In case one should be bitten, the best procedure would be approximately as follows: apply a tourniquet above the region of the bite immediately, make a cross-cut at the site of the bite, suck out the poison as well as possible, get to a physician at once. *But take no stimulants!* Stimulants merely augment the spread of the venom. An intoxicated person's best recourse might be prayer. Black Widows are deadly, any articles to the contrary notwithstanding. A Russian scientist found that, if applied to best advantage, (in saline solution) the poison from one of these spiders is potent enough to kill a thousand cats. (One is not allowed to perform such experiments upon human beings, for some strange reason.)

In my work with *Latrodectus* I am collecting data upon the developmental stages, with regard to differential feeding, ecdyses, markings, etc. At present I have about thirty-five healthy specimens and a few sickly ones. Later I intend to test their potency and carry on various experiments with the little fellows. May they thrive!

Chapter News Letters

Epsilon

—University of Denver

At the initiation banquet held on January fifteenth Epsilon Chapter inducted five pledges into membership. The new members are: Helen Dexter, William Driscoll, Don Guthrie, Lorin Mickey, and Elizabeth Love. The guest speaker was Dr. George A. Filmer, prominent Denver ophthalmologist, who spoke on common eye defects and diseases.

In accordance with the custom of our chapter each initiate presented a paper on original research. The titles were as follows: "The Maximum Exposure of Palisade Parenchyma Surface" by Don Guthrie; "The Histological Appearance of Notochordal Tissue in *Amphioxus*, Chick, and Pig" by William Driscoll; "Spermatogenesis in Testis of Salamander *Amblystoma tigris*" by Lorin Mickey; "Histological Difference Between Male and Female Gonads of *Amphioxus*" by Helen Dexter; and "Histological Gill Structure of *Mytilus californianus*" by Elizabeth Love.

Epsilon Chapter was very happy to welcome our national secretary, Dr. Ortenburger, who had luncheon with us February fifth at the University of Denver Student Union. He was on his way to Missoula, Montana, to attend the twentieth anniversary of the founding of Lambda Chapter at Montana State University.

Our next meeting is to be an open one. Each member is to invite two or three persons who are majoring in a biological science. In this way we feel that prospective members as well as other students will become better acquainted with Phi Sigma.

BYRON L. MILLER, JR., *Secretary*.

Zeta

—University of Wisconsin

On January 23rd, just before final examinations for the first semester, we got together, in spite of the hovering dark clouds to listen to an illustrated lecture on "What is Paleontology?" by Dr. Newell of our Department of Geology, who came to our campus from the Kansas University Chapter. This lecture was followed on February 13th by a discussion of recent developments in food preservation by Dr. Frazier, Professor of Agricultural Bacteriology. Dr. Frazier is a man of wide experience including ten years with the Bureau of Dairy Industry of the U. S. D. A., who conducts a very popular and instructive course in Food Bacteriology here on the campus. Our last meeting at this time of writing was on February 27th, when Professor Bryan of the Biology Department lectured on "Eight Degrees South," some of the material and illustrations being the result of his travels in South America with a group representing the Field Museum, and his own expedition into East Africa.

A. IRVING COOMBS, *Editor*.

Eta

—University of Akron

Eta Chapter has pursued a successful program for the year of 1941. Our programs consisted of short talks by members of the organization concerning fields in which the members had done considerable work or in which he was particularly interested. Insect Flight, Tuberculosis Diagnosis, Symbiotism, Leprosy, Sulphanilamide, and Bird Banding were some of the subjects treated.

The Chapter takes pleasure in announcing the initiation of Jane Scheffler, William Koerschner, Harry Rosenthal, and Earl Long. Pledging of Donald McGaughey and Charles St. John is also to be announced.

C. RICHARD WEAVER, *Secretary*.

Mu

—University of California

The first meeting of the spring semester was held on January 29th with about 60 members and guests present. This large attendance indicates the interest shown in the topic of the evening, "Science in the Soviet Union," which was presented by Dr. J. Oserkowsky, a plant physiologist recently returned from a two-and-a-half year stay in that country, where he had paid special attention to the tea crop. The speaker described the importance and activities of the All-Union Academy of Sciences and the general character of the scientific work with which he was familiar. He stressed the fact that although on the one hand scientists are supplied with ample equipment and facilities, they are subject to strict political supervision and individual efforts off the beaten track are discouraged.

The Paleontology Department held an Open House for Phi Sigma on February 18th, during which Professors C. L. Camp and B. L. Clark and graduate students Pierina Rossello and Elizabeth Richardson conducted us on a tour of the Museum and Research Laboratories. They demonstrated the methods of collecting and preparing fossils for study, the preserving and classifying of such material, and some of the more interesting specimens at the Museum. Much progress has been made here in the study of the prehistoric flora and fauna of Western North America. Of particular interest has been the paleontological history of California, in which the once great inland sea where now is the San Joaquin Valley, played a dominant role.

NATHAN STAHLER, *Secretary*.

Rho

—University of Illinois

Rho Chapter has had a very active and fruitful year. A schedule of regular meetings attracted an average of almost thirty members per meeting.

In November, Thomas Lord, Joseph Fulton, William Leavenworth, Reed Fautin, Roger Williams, Russell Hager, and Clayton Hoff gave short discussions on the work they were doing in Bacteriology, Botany, Ecology, Entomology and Zoology.

In accordance with our chapter's custom the December meeting and the fall initiation were combined. Five new members were initiated: Dr. Victor E. Shelford, Honorary, Dale W. Jenkins, Ralph M. Wetzel, William C. Leavenworth, Chester W. Houston. Dr. Neil Stevens of the Botany Department gave the address of the evening. His subject was "Applied Botany as Fun."

Dr. Victor E. Shelford, our honorary member, has been one of the outstanding leaders in the field of Animal Ecology for many years. His name is associated with almost every branch of Ecology, and particularly with insect and aquatic ecology, with the development of ecological instruments and techniques, and with the fundamental concepts themselves of this branch of biological science. His textbooks and papers are known and read wherever students study Ecology. We feel that Rho Chapter and Phi Sigma Society are honored by his affiliation with us, and we look forward to many pleasant associations with him.

In January our group was addressed by Dr. C. E. McClung, visiting professor of Zoology from the University of Pennsylvania. Dr. McClung spoke about his many interesting experiences as an exchange professor of Zoology in Japan.

Dr. H. J. Van Cleave entertained us in February with an account of the history of Zoology at the University of Illinois.

Our most recent meeting was held in the University Observatory where members of the chapter indulged in star-gazing through the University telescope. Imaginations roamed to other planets and other worlds in the very

lively discussion that followed, led by Professor R. H. Baker.

Our activities will close with the annual spring initiation banquet to be held in May. The officers of Rho Chapter wish to take this opportunity to extend their best wishes to fellow Phi Sigma members everywhere!

WILLIAM G. GAMBELL, JR., *Secretary*.

Sigma

—University of Florida

1940—PROGRAM—1941

Sept. 23—Business Meeting.

Oct. 21—Lecture by Dr. G. E. Coghill, "The Structure of the Nervous System and the Development of Behavior."

Nov. 4—Business Meeting.

Dec. 6—Annual Banquet and Fall Initiation. Speaker, Prof. W. J. K. Harkness.

Feb. 10—Lecture by Dr. M. A. Brannon, "Growth Substances and Some Physiological Responses."

Feb. 24—Speaker, Dr. M. A. Brannon, "Growth Substances and Some Pathological Responses."

March 3—Business Meeting, Election of New Members and Officers.

March 17—Lecture by Dr. M. A. Brannon, "Some Hydrobiological Laboratories in Europe and America."

April 19—Outdoor Supper, Spring Initiation, Installation of Officers.

May 12—Final "Get-Together," A Program of Selected Pictures.

Upsilon

—Miami University

Phi Sigma at Miami University has been an active group during the first semester of this year, although the membership has not been high. Professors of the various Scientific Departments of the University have spoken to the group: Dr. Shideler spoke on the topic, "Human Paleontology"; Dr. Molnar presented a series of demonstrations on the "Electrodynamics of Muscle Tissue"; Dr. Stark lectured on the coming "Fields of Bacteriology."

The group will initiate about 20 new members on the 27th of March. The initiation will be followed with a dinner and a lecture by Dr. O. L. Inman of Antioch College. Dr. Inman is Director of the C. F. Kettering Foundation for the Study of Chlorophyll and Photosynthesis. He will speak to Phi Sigma about the research work that he has accomplished in working with the Kettering Foundation.

J. T. HOWELL.

Alpha Eta

—Oklahoma Agricultural and Mechanical College

Alpha Eta Chapter held its annual fall formal initiation and banquet at "Ye Olde Inn" on December 15th. After the dinner, Mr. A. D. Buck, head of the Biological Department at the Tonkawa Jr. College, told of his experiences as a ranger in Yosemite National Park.

Neophytes initiated into the Alpha Eta Chapter were Ernest Berousek, Eugene Brock, Thomas Brown, Dent Burgess, Clifford Burton, Gertrude Cawley, Dorothy Cristy, Sherwin Eckley, J. C. Garrett, Elizabeth Gray, Francis Harper, Robert Hodges, John Hollis, Herbert Ikenberry, Wayne Jackson, Lon McGilliard, Edmund Staley, William Dinnusson, and James O. Murphy.

The Chapter has just recently completed a new specimen show case which is located in the new Science Building; all interesting displays will be shown there.

MARGUERITE HUTCHINSON, *Secretary*.

Alpha Iota

—Bucknell University

Alpha Iota Chapter held an impressive pledging ceremony in connection with the regular monthly meeting on December 17. At this time, there were eight students pledged to the society. They were as follows: Lilyanne Babski, Josephine Bagg, Marjorie Clayton, Evelyn Homewood, Mary Ellen Osterle, Alfred Ashman, Clark Biddleman, and Robert Krout.

At the January Monthly Meeting, the delegates to the Philadelphia meeting

of the American Association for the Advancement of Science gave very interesting accounts of the exhibitions and meetings which they had attended.

Dr. William H. Eyster, Professor of Botany at Bucknell University, was the speaker at the January Open Meeting held on January 21st. He gave a very interesting illustrated lecture on the application of scientific methods which are learned in college.

The Phi Sigma Scholarship Award was presented to a member of the Alpha Iota Chapter, Lois Farley, at the semi-annual Convocation Service.

A second Pledging Ceremony was held during the regular monthly meeting on February 11th, at which time four students were pledged. They are as follows: Melvin Knupp, Carolyn Foust, Germaine Roshon, and Donald Eister.

The chapter was the guest of the Alpha Phi Sigma Society on February 12th at a lecture on "The Chemistry of Vitamins and Hormones."

The Phi Sigma Hiking Club, which has been very active, sponsored a very successful week-end trip to the Christian Association Cabin at Cowan the week-end of February 21st. An all-day trip to Woodward is being planned for sometime in April. Professor Peltiers, Professor of Geology, will accompany the group.

Dr. Stainsby, Surgeon at Geisinger Hospital, Danville, Pennsylvania, gave an illustrated lecture on the "Disturbances of the Heart and Circulatory System of the College Age Student" at the February Open Meeting.

Mr. Charles Moore will be the speaker at the March Open Meeting which will be held March 26th. His subject will be "Dusk to Dawn," a lecture on the activities of nocturnal animal life.

LOIS R. FARLEY, *Secretary*.

Alpha Nu

—University of New Mexico

During the past few months Alpha Nu Chapter has sponsored a series of talks covering a wide field. The first lecture, since our last news letter, was given by a Graduate Fellow in the Biology Department, Charles Fuller, on

a 2100-mile canoe trip in Northern Canada. He also showed us some excellent films taken all along the way. On November 7th, we had a talk by Dr. E. L. Flory on the types of grasses in the Southwest and their relationship to erosion. The following talk was given by Dr. L. S. Gill on forest pathology, especially in the Southwest, and illustrated with color slides. Dr. V. H. Spensely spoke next on blood coagulation in connection with his interesting and unusually successful results in experiments with cucumber juice to stop hemorrhages during and after dental operations.

On December 19th Alpha Nu initiated twelve new members. The initiates were: Thomas Capraro, Charles Fuller, Earl Gerheim, Conrado Gutierrez, Virginia Horton, Wallace Lloyd, Evergilio Martinez, George Prothro, Wayne Springfield, David Stevens, Maurice Thompson, and Mary Worman.

Following the initiation, a banquet was held at the Franciscan Hotel. The speaker for the evening was Dr. R. E. Holzer, whose topic was, "The Relation of Physics to the Problems of Biology and Medicine." Dr. Willis Bell, acting toastmaster, carried class-room procedure into the banquet room by giving us a test on biology puns! The new initiates presented a skit "On the Coming of Spring"—By Ology—in pantomime with Tom Capraro acting as commentator. Charlotte Goodding was in charge of the arrangements for the most successful banquet Alpha Nu has ever had.

Second semester activities for Alpha Nu started out with a talk by Dr. George E. Peterson on chemical equivalents of practice in the nervous system. Dr. Peterson's lecture was a report of his recent research work on acetylcholine in the nervous system of white rats.

On February 20th we had our annual Phi Sigma party, the price of admission for which was one biological specimen. A mock "Information Please" radio program was given, only instead of Encyclopedias Britannicas, lollipops were passed out. Other competitive games were played and prizes such as a pair of white rats and a water dog were given.

MARY DUNN JAMISON, *Secretary*.

New Books

Except for the Review of *HELL'S BELLS*, the thumbnail sketches of current biological literature appearing in this section are not meant to be exhaustive or deeply critical. They aim to survey the rapidly growing field of biology. Naturally these reviews represent the candid opinions of various readers not necessarily those of the National Council, nor even those of the editor.

HELL'S BELLS, A. S. PEARSE, *The Seeman Printery Incorporated, Durham, North Carolina, 1941.*

A successful treatise on society, written by a scientist, to portray society and individuals, with all their good and bad aspects. The roles played by faith, fear, love, laws, and education, bring forth the strong and weak characteristics of individuals and society in general. "Religion gives a man who 'belongs' power." The church authorities take advantage of the good and bad members and give rewards to the good. Hell's Bells represents the types of penalties invented by the executives of the church, for the types and degrees of suffering the disloyal must suffer as punishment for their sins.

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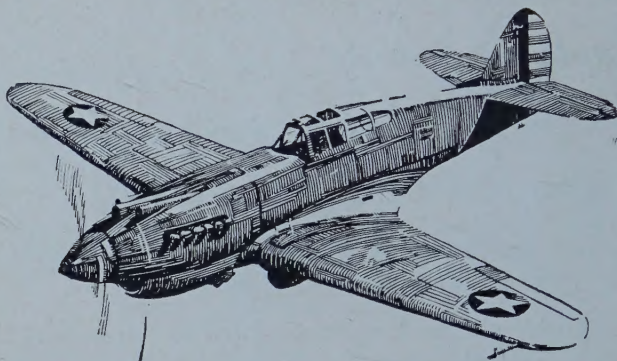
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